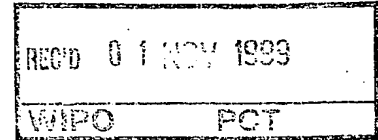


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AN IMPROVED METHOD for extracting quantitative information relating to an influence on a cellular response.

## SUMMARY OF THE INVENTION

5 The present invention relates to an improved method and tools for extracting quantitative information relating to an influence on a cellular response, in particular an influence caused by contacting or incubating the cell with a substance influencing a cellular response, wherein the cellular response is manifested in redistribution of at least one component in the cell. In particular, the invention relates to an improved method for  
10 extracting the quantitative information relating to an influence on an intracellular pathway involving redistribution of at least one component associated with the pathway. The method of the invention may be used as a very efficient procedure for testing or discovering the influence of a substance on a physiological process, for example in connection with screening for new drugs, testing of substances for toxicity, identifying  
15 drug targets for known or novel drugs. In particular, the present invention relates to an improved method for parallelisation of the testing procedure so that a large number of substances can be tested simultaneously using commercially available instrumentation. The invention also describes several ways of contacting the cells with a substance influencing a cellular response and modifications made to the actual cells before, during or  
20 after contacting the cells with these substances as to improve the applicability and use of the method for extracting quantitative information relating to influence on an intracellular pathway in a highly parallel fashion. Other valuable uses of the method and technology of the invention will be apparent to the skilled person on the basis of the following disclosure. In a particular embodiment of the invention, the present invention relates to a method of  
25 detecting intracellular translocation or redistribution of biologically active polypeptides, preferably an enzyme, affecting intracellular processes, and a DNA construct and a cell for use in the method.

Two appendices are included herein, and are considered part of the application. Appendix I, "METHOD AND APPARATUS FOR HIGH DENSITY FORMAT SCREENING FOR  
30 BIOACTIVE MOLECULES", is a pending patent application. Appendix II, "CHANGES

IN INTRACELLULAR cAMP VISUALIZED USING A cAMP-DEPENDENT PROTEIN KINASE-GREEN FLUORESCENT PROTEIN HYBRID", is a manuscript intended for publication.

## 5 BACKGROUND OF THE INVENTION

Intracellular pathways are tightly regulated by a cascade of components that undergo modulation in a temporally and spatially characteristic manner. Several disease states can be attributed to altered activity of individual signalling components (i.e. protein kinases, protein phosphatases, transcription factors). These components therefore render  
10 themselves as attractive targets for therapeutic intervention.

Protein kinases and phosphatases are well described components of several intracellular signalling pathways. The catalytic activity of protein kinases and phosphatases are assumed to play a role in virtually all regulatable cellular processes. Although the involvement of protein kinases in cellular signalling and regulation have been subjected to  
15 extensive studies, detailed knowledge on e.g. the exact timing and spatial characteristics of signalling events is often difficult to obtain due to lack of a convenient technology.

Novel ways of monitoring specific modulation of intracellular pathways in intact, living cells is assumed to provide new opportunities in drug discovery, functional genomics, toxicology, patient monitoring etc.

20 The spatial orchestration of protein kinase activity is likely to be essential for the high degree of specificity of individual protein kinases. The phosphorylation mediated by protein kinases is balanced by phosphatase activity. Also within the family of phosphatases translocation has been observed, e.g. translocation of PTP2C to membrane ruffles [(Cossette *et al.* 1996)], and likewise is likely to be indicative of phosphatase activity.

25 Protein kinases often show a specific intracellular distribution before, during and after activation. Monitoring the translocation processes and/or redistribution of individual protein kinases or subunits thereof is thus likely to be indicative of their functional activity. A connection between translocation and catalytic activation has been shown for

protein kinases like the diacyl glycerol (DAG)-dependent protein kinase C (PKC), the cAMP-dependent protein kinase (PKA) [(DeBernardi *et al.* 1996)] and the mitogen-activated-protein kinase Erk-1 [(Sano *et al.* 1995)].

Commonly used methods of detection of intracellular localisation/activity of protein  
5 kinases and phosphatases are immunoprecipitation, Western blotting and immunocytochemical detection.

Taking the family of diacyl glycerol (DAG)-dependent protein kinase Cs (PKCs) as an example, it has been shown that individual PKC isoforms that are distributed among different tissues and cells have different activator requirements and undergo differential  
10 translocation in response to activation. Catalytically inactive DAG-dependent PKCs are generally distributed throughout the cytoplasm, whereas they upon activation translocate to become associated with different cellular components, e.g. plasma membrane [(Farese, 1992),(Fulop Jr. *et al.* 1995)] nucleus [(Khalil *et al.* 1992)], cytoskeleton [(Blobe *et al.* 1996)]. The translocation phenomenon being indicative of PKC activation has been  
15 monitored using different approaches: a) immunocytochemistry where the localisation of individual isoforms can be detected after permeabilisation and fixation of the cells [(Khalil *et al.* 1992)]; and b) tagging all DAG-dependent PKC isoforms with a fluorescently labelled phorbol myristate acetate (PMA) [(Godson *et al.* 1996)]; and c) chemical tagging of PKC  $\beta$ 1 with the fluorophore Cy3 [(Bastiaens & Jovin 1996)] and d) genetic tagging of  
20 PKC  $\alpha$ [(Schmidt *et al.* 1997)] and of PKC  $\gamma$  and PKC  $\delta$  [(Sakai *et al.* 1996)]. The first method does not provide dynamic information whereas the latter methods will. Tagging PKC with fluorescently labelled phorbol myristate acetate cannot distinguish between different DAG-dependent isoforms of PKC but will label and show movement of all isoforms. Chemical and genetic labelling of specific DAG-dependent PKCs confirmed that  
25 they in an isoform specific manner upon activation move to cell periphery or nucleus.

In an alternative method, protein kinase A activity has been measured in living cells by chemical labelling one of the kinase's subunit [(Adams *et al.* 1991)]. The basis of the methodology is that the regulatory and catalytic subunit of purified protein kinase A is labelled with fluorescein and rhodamine, respectively. At low cAMP levels protein kinase  
30 A is assembled in a heterotetrameric form which enables fluorescence resonance energy



transfer between the two fluorescent dyes. Activation of protein kinase A leads to dissociation of the complex, thereby eliminating the energy transfer. A disadvantage of this technology is that the labelled protein kinase A has to be microinjected into the cells of interest. This highly invasive technique is cumbersome and not applicable to large scale screening of biologically active substances. A further disadvantage of this technique as compared to the presented invention is that the labelled protein kinase A cannot be inserted into organisms/animals as a transgene.

Recently it was discovered that Green Fluorescent Protein (GFP) expressed in many different cell types, including mammalian cells, became highly fluorescent [(Chalfie *et al.* 1994)]. WO95/07463 describes a cell capable of expressing GFP and a method for detecting a protein of interest in a cell based on introducing into a cell a DNA molecule having DNA sequence encoding the protein of interest linked to DNA sequence encoding a GFP such that the protein produced by the DNA molecule will have the protein of interest fused to the GFP, then culturing the cells in conditions permitting expression of the fused protein and detecting the location of the fluorescence in the cell, thereby localizing the protein of interest in the cell. However, examples of such fused proteins are not provided, and the use of fusion proteins with GFP for detection or quantitation of translocation or redistribution of biologically active polypeptides affecting intracellular processes upon activation, such as proteins involved in signalling pathways, e.g. protein kinases or phosphatases, has not been suggested. WO 95/07463 further describes cells useful for the detection of molecules, such as hormones or heavy metals, in a biological sample, by operatively linking a regulatory element of the gene which is affected by the molecule of interest to a GFP, the presence of the molecules will affect the regulatory element which in turn will affect the expression of the GFP. In this way the gene encoding GFP is used as a reporter gene in a cell which is constructed for monitoring the presence of a specific molecular identity.

Green Fluorescent Protein has been used in an assay for the detection of translocation of the glucocorticoid receptor (GR) [(Carey, KL *et al.* 1996)]. A GR-S65TGFP fusion has been used to study the mechanisms involved in translocation of the glucocorticoid receptor (GR) in response to the agonist dexamethasone from the cytosol, where it is present in the absence of a ligand, through the nuclear pore to the nucleus where it remains after ligand

binding. The use of a GR-GFP fusion enables real-time imaging and quantitation of nuclear/cytoplasmic ratios of the fluorescence signal. A similar genetic construct has been used to follow and quantify dexamethasone induced translocation of GR to the nucleus in HeLa cells [(Guiliano, K.A *et al.* 1997)] in a system called Array Scan™ (WO 97/45730) designed for automated drug screening. Recently, several other investigators have demonstrated that tagging a specific protein (or part of a protein) involved in an intracellular signalling pathway with GFP provides a new means to measure and quantify the influence of substances on this pathway. The concept has been shown to work both for cytoplasmic to nuclear translocation of the androgen receptor [(Georget V *et al.* 1997)] and transcription factors such as NF-ATc [(Beals CR *et al.* 1997)] in analogy with what has already been described for GR above. Another relevant example is a  $\beta$ -arrestin – GFP construct that was shown to report on activation of G-protein coupled receptors by translocating from the cytosol to the plasma membrane [(Barak LS *et al.* 1997)]. Finally, it has also been demonstrated that attaching GFP to a smaller part of a protein like the pleckstrin homology domain of phospholipase C  $\delta$  1 [(Stauffer TP *et al.* 1998)] and a cysteine-rich domain of PKC  $\gamma$  [(Oancea E *et al.* 1998)] can be used to report on an influence from a substance by quantifying their redistribution within the cells during activation of the specific signalling pathway to which they belong.

Many currently used screening programmes designed to find compounds that affect protein kinase activity are based on measurements of kinase phosphorylation of artificial or natural substrates, receptor binding and/or reporter gene expression. The interest in fluorescence measurements as the basis for future high-throughput drug screening has however increased dramatically over the last few years [(Silverman L *et al.* 1998)]. Of particular interest to the present invention is a scanning laser imager for rapid screening of fluorescence changes in living cells [(Schroeder K & Neagle B 1996)] currently offered commercially by Molecular Devices, Inc. as the FLIPR™.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention provides an important new dimension in the investigation of cellular systems involving redistribution in that the invention provides quantification of the

redistribution responses or events caused by an influence, typically contact with a chemical substance or mixture of chemical substances, but also changes in the physical environment. The quantification makes it possible to set up meaningful relationships, expressed numerically, or as curves or graphs, between the influences (or the degree of influences) on cellular systems and the redistribution response. This is highly advantageous because, as has been found, the quantification can be achieved in both a fast and reproducible manner, and - what is perhaps even more important - the systems which become quantifiable utilising the method of the invention are systems from which enormous amounts of new information and insight can be derived.

10 The present screening assays have the distinct advantage over other screening assays, e.g., receptor binding assays, enzymatic assays, and reporter gene assays, in providing a system in which biologically active substances with completely novel modes of action, e.g. inhibition or promotion of redistribution/translocation of a biologically active polypeptide as a way of regulating its action rather than inhibition/activation of enzymatic activity, can be identified in a way that insures very high selectivity to the particular isoform of the biologically active polypeptide and further development of compound selectivity versus other isoforms of the same biologically active polypeptide or other components of the same signalling pathway.

In its broadest aspect, the invention relates to an improved method, with higher throughput compared to previous methods, for extracting quantitative information relating to an influence on a cellular response, the method comprising recording variation, caused by the influence on mechanically intact living cells, in spatially distributed light emitted from a luminophore, the luminophore being present in the cells and being capable of being redistributed in a manner which is related with the degree of the influence, and/or of being modulated by a component which is capable of being redistributed in a manner which is related to the degree of the influence, the association resulting in a modulation of the luminescence characteristics of the luminophore, detecting and recording the spatially distributed light from the luminophore, and processing the recorded variation in the spatially distributed light to provide quantitative information correlating the spatial distribution or change in the spatial distribution to the degree of the influence. In one aspect of the present invention the mechanically intact living cell is permeabilised at some

time after the influence has begun but during or before the actual experimental recording. In another aspect, the present invention relates to an improved method for extracting quantitative information relating to an influence on a cellular response, the method comprising recording variation, caused by the influence on permeabilised living cells, in spatially distributed light emitted from a luminophore, the luminophore being present in the cells and being capable of being redistributed in a manner which is related with the degree of the influence, and/or of being modulated by a component which is capable of being redistributed in a manner which is related to the degree of the influence, the association resulting in a modulation of the luminescence characteristics of the luminophore, detecting and recording the spatially distributed light from the luminophore, and processing the recorded variation in the spatially distributed light to provide quantitative information correlating the spatial distribution or change in the spatial distribution to the degree of the influence. In a preferred embodiment of the invention the luminophore, which is present in the cells, is capable of being redistributed by modulation of an intracellular pathway, in a manner which is related to the redistribution of at least one component of the intracellular pathway. In another preferred embodiment of the invention, the luminophore is a fluorophore.

In the invention the cell and/or cells are mechanically intact and alive throughout the experiment. In another embodiment of the invention, the cells are fixed at a point in time after the application of the influence at which the response has been predetermined to be significant, and the recording is made at an arbitrary later time. In another embodiment the cell and/or cells are mechanically intact and alive throughout the experiment but are mechanically or chemically disrupted or permeabilised as the initial step of experimental analysis. In another aspect of the invention the cells have their plasma membrane permanently and stably permeabilised before the initiation of the experiment in such a way that the plasma membrane stays permeable during the experiment. This allows the components of intracellular pathways to be contacted by substances that are not normally permeating the cell plasma membrane such as peptides, proteins and hydrophilic organic compounds.

The mechanically intact or permeabilised living cells could be selected from the group consisting of fungal cells, such as yeast cells; invertebrate cells including insect cells; and

vertebrate cells, such as mammalian cells. These cells are incubated at a temperature of 30°C or above, preferably at a temperature of from 32°C to 39°C, more preferably at a temperature of from 35°C to 38°C, and most preferably at a temperature of about 37°C during the time period over which the influence is observed. In one aspect of the invention the mechanically intact or permeabilised living cell is part of a matrix of identical or non-identical cells. In one embodiment of the invention the cells comprise a group or groups of cells contained within a spatial limitation or spatial limitations. In one embodiment, the cells comprise multiple groups of cells that are qualitatively the same but subjected to different influences. In another embodiment, the cells comprise multiple groups of cells that are qualitatively different but subjected to the same influence.

In one embodiment of the invention the spatial limitations are domains defined on a substrate on which the cells are present. The spatial limitations may be arranged in one or more arrays on a common carrier. The spatial limitations may be wells in a plate of microtiter type, such that 96, 384, 864 and 1536 wells are situated on the common carrier. In another embodiment the spatial limitations are wells in a plate of a format different from the microtiter type. In one embodiment of the invention the domains are established by the presence of the cells on the substrate in a pattern that defines the domains. In another aspect of the invention, the domains are instead established by the spatial pattern or array of the influence or influences as it/they are applied to or contacted by the cells. This aspect is thoroughly described in Appendix I. Briefly, in this aspect of the invention the mechanically intact or permeabilised living cells are part of a continuous or discontinuous sheet of cells cultured on an optically clear flat surface optimised or not for cell culture. The optically clear and flat surface may be a porous membrane that may allow cellular processes to grow through the membrane pores and may allow directed capillary flow of fluid through the pores.

A cell used in the present invention should contain a nucleic acid construct encoding a fusion polypeptide as defined herein and be capable of expressing the sequence encoded by the construct. The cell is a eukaryotic cell selected from the group consisting of fungal cells, such as yeast cells; invertebrate cells including insect cells; vertebrate cells such as mammalian cells. The preferred cells are mammalian cells.

In another aspect of the invention the cells could be from an organism carrying in at least one of its component cells a nucleic acid sequence encoding a fusion polypeptide as defined herein and be capable of expressing said nucleic acid sequence. The organism is selected from the group consisting of unicellular and multicellular organisms, such as a mammal.

The luminophore is the component that allows the redistribution to be visualised and/or recorded by emitting light in a spatial distribution related to the degree of influence. The term redistribution is intended to cover all aspects of a change in spatial location, such as a translocation of the luminophore or other components. In one embodiment of the invention, the luminophore is capable of being redistributed in a manner that is physiologically relevant to the degree of the influence. It should be understood that redistribution. In another embodiment, the luminophore is capable of associating with a component that is capable of being redistributed in a manner that is physiologically relevant to the degree of the influence. In another embodiment, a correlation between the redistribution of the luminophore and the degree of the influence could be determined experimentally. In a preferred aspect of the invention, the luminophore is capable of being redistributed in substantially the same manner as the at least one component of an intracellular pathway. In another embodiment of the invention, the luminophore is capable of being quenched upon spatial association with a component that is redistributed by modulation of the pathway, the quenching being measured as a change in the intensity of the luminescence. In another embodiment of the invention, the luminophore is stationary but may have a certain spatial distribution, and interacts with at least one component that is capable of being redistributed in a manner which is physiologically relevant to the degree of the influence, in such a way that one or more luminescence characteristics of the luminophore is/are modulated as the component moves closer to, or farther from, the luminophore.

The luminophore could be a fluorophore. In a preferred embodiment of the invention, the luminophore is a polypeptide encoded by and expressed from a nucleotide sequence harboured in the cells. The luminophore could be a hybrid polypeptide comprising a fusion of at least a portion of each of two polypeptides one of which comprises a luminescent polypeptide and the other one of which comprises a biologically active polypeptide, as

defined herein.

The luminescent polypeptide could be a GFP as defined herein or could be selected from the group consisting of green fluorescent proteins having the F64L mutation as defined herein such as F64L-GFP, F64L-Y66H-GFP, F64L-S65T-GFP, and EGFP. The GFP could  
5 be N- or C-terminally tagged, optionally via a peptide linker, to the biologically active polypeptide or a part or a subunit thereof. The fluorescent probe could be a component of an intracellular signalling pathway. The probe is coded for by a nucleic acid construct.

The pathway of investigation in the present invention could be an intracellular signalling pathway.

10 In a preferred embodiment of the invention, the influence could be contact between the group or groups of mechanically intact or permeabilised living cells and a chemical substance, and/or incubation of the group or groups of mechanically intact or permeabilised living cells with a chemical substance in solution. In one aspect of the invention that is thoroughly described in Appendix I, the chemical substances are attached  
15 to an underlying matrix. In this aspect, the chemical substances may also be produced and secreted from, or attached to the plasma membrane surfaces of, a sheet of genetically engineered cells. In this aspect of the invention the chemical substances may also have been separated two-dimensionally in a non-denaturing gel using electrophoresis and the gel is directly put in close proximity or direct contact with the mechanically intact or  
20 permeabilised living cells so that the chemical substances can contact the cells through diffusion or convection.

The influence will modulate the intracellular processes. In one aspect the modulation could be an activation of the intracellular processes. In another aspect the modulation could be a deactivation of the intracellular processes. In yet another aspect, the influence could inhibit  
25 or promote the redistribution without directly affecting the metabolic activity of the component of the intracellular processes.

In one embodiment the invention is used to establish a dose-response relationship for one or many chemical substances. In one embodiment the invention is used as a basis for a screening program, where the effect of unknown influences such as a compound library,

can be compared to influence of known reference compounds under standardised conditions.

In addition to the intensity, there are several parameters of fluorescence or luminescence that can be modulated by the effect of the influence on the underlying cellular phenomena, and can therefore be used in the invention. Some examples are resonance energy transfer, fluorescence lifetime, polarisation, and wavelength shift. Each of these methods requires a particular kind of filter in the emission light path to select the component of the light desired and reject other components. The recording of property of light could be in the form of an ordered array of values such as a CCD array or a vacuum tube device such as a vidicon. In addition, the translational mobility, or freedom of movement, of the luminophore attached to the protein of interest can be an important property affected by the influence on the underlying cellular phenomena, and can therefore be used in the invention.

In one embodiment of the invention, the spatially distributed light emitted by a luminophore is detected by a change in the resonance energy transfer between the luminophore and another luminescent entity capable of delivering energy to the luminophore, each of which has been selected or engineered to become part of, bound to or associated with particular components of the intracellular pathway. In this embodiment, either the luminophore or the luminescent entity capable of delivering energy to the luminophore undergoes redistribution in response to an influence. The resonance energy transfer would be measured as a change in the intensity of emission from the luminophore, preferably sensed by a single channel photodetector that responds only to the average intensity of the luminophore in a non-spatially resolved fashion.

In one embodiment of the invention, the spatially distributed light emitted by a luminophore includes the case of uniform spatial distribution of the light.

In one aspect of the invention, the luminophore is a fluorophore which redistributes through a non-homogenous excitation light field, resulting in a change in the intensity of the light emitted from the luminophore as a result of the change in the amount of excitation light intensity at different points in the field.



In one embodiment of the invention, the recording of the spatially distributed light could be made at a single point in time after the application of the influence. In another embodiment, the recording could be made at two points in time, one point being before, and the other point being after the application of the influence. The result or variation is  
5 determined from the change in fluorescence compared to the fluorescence measured prior to the influence or modulation. In another embodiment of the invention, the recording could be performed at a series of points in time, in which the application of the influence occurs at some time after the first time point in the series of recordings, the recording being performed, e.g., with a predetermined time spacing of from 0.1 seconds to 1 hour,  
10 preferably from 1 to 60 seconds, more preferably from 1 to 30 seconds, in particular from 1 to 10 seconds, over a time span of from 1 second to 12 hours, such as from 10 seconds to 12 hours, e.g., from 10 seconds to one hour, such as from 60 seconds to 30 minutes or 20 minutes. The result or variation is determined from the change in fluorescence over time. The result or variation could also be determined as a change in the spatial distribution of  
15 the fluorescence over time.

In one embodiment the recording comprises a time series of total luminescence of the cells of one or several of the spatial limitations. In one embodiment the signal from all of the spatial limitations, one at a time, is measured by a recording being made in the individual  
20 spatial limitations by means of an apparatus to sequentially position each one of the limitations in the field of view of the detector and repeating the positioning and measurement process until all of the spatial limitations have been measured. The detector may be a photomultiplier tube. In a preferred embodiment of the present invention more than one spatial limitation is measured simultaneously. This may be done by means of a one- or two-dimensional array detector, whereby the multiple spatial limitations are  
25 imaged onto the array detector such that discrete subsets of the detecting units (pixels) in the array detector measure the signal from one and only one of the multiple spatial limitations, the signal from any one spatial limitation being the combined signal from those pixels that receive the image from one of the spatial limitations. This array detector may be a linear diode array, a video camera (according to any present or future standards  
30 and definitions of image acquisition and transmission) or a charge transfer device such as a charge-coupled device (CCD). In one embodiment the recording of signal requires

illumination of the multiple spatial limitations to excite the luminophores so that they emit light. In one embodiment all of the spatial limitations are simultaneously illuminated during the measurement. In another embodiment the spatial limitations are singly illuminated only during the time in which they are being measured. In a preferred  
5 embodiment the illumination is provided by a laser that is scanned in a raster fashion over some or all of the spatial limitations being measured. The scanning may take place at a rate that is substantially faster than the measurement process such that the illumination appears to the measurement process to be continuous in time and spatially uniform over the region being measured.

- 10 The recording of spatially distributed luminescence emitted from the luminophore is performed by an apparatus for measuring the distribution of fluorescence in the cells, and thereby any change in the distribution of fluorescence in the cells, which includes at a minimum the following component parts: (a) a light source, (b) a method for selecting the wavelength(s) of light from the source which will excite the luminescence of the  
15 luminophore, (c) a device which can rapidly block or pass the excitation light into the rest of the system, (d) a series of optical elements for conveying the excitation light to the specimen, collecting the emitted fluorescence in a spatially resolved fashion, and forming an image from this fluorescence emission (or another type of intensity map relevant to the method of detection and measurement), (e) a bench or stand which holds the container of  
20 the cells being measured in a predetermined geometry with respect to the series of optical elements, (f) a detector to record the spatially resolved fluorescence in the form of an image, (g) a computer or electronic system and associated software to acquire and store the recorded images, and to compute the degree of redistribution from the recorded images.

In a preferred embodiment of the invention the apparatus system is automated. In one  
25 embodiment the components in d and e mentioned above comprise a fluorescence microscope. In one embodiment the component in f mentioned above is a CCD camera. In one embodiment the component in f mentioned above is an array of photomultiplier tubes/devices.

In one embodiment the image is formed and recorded by an optical scanning system.

- 30 In one embodiment the optical scanning system is used to illuminate the bottom of a plate

of microtiter type so that a time-resolved recording of changes in luminescence or fluorescence can be made from all spatial limitations simultaneously.

In a preferred embodiment the actual luminescence or fluorescence measurements are made in a FLIPR™ instrument, commercially available from Molecular Devices, Inc.

- 5 In one embodiment of the invention the actual fluorescence measurements are made in a standard type of fluorometer for plates of microtiter type (fluorescence plate reader).

In one embodiment a liquid addition system is used to add a known or unknown compound to any or all of the cells in the cell holder at a time determined in advance. Preferably, the liquid addition system is under the control of the computer or electronic system. Such an automated system can be used for a screening program due to its ability to generate results from a larger number of test compounds than a human operator could generate using the apparatus in a manual fashion.

The methods whereby the detector layer of cells are physically contacted by the compounds can also be of another conceptual type where the compounds are delivered to the cells through a porous membrane by convection/diffusion or by directly contacting compounds attached to an inorganic or organic support (such as glass, plastic or the plasma membrane of intact living cells) with the cells. These methods are thoroughly described in Appendix I, but are also outlined in the following paragraphs.

In one aspect of the present invention where the detector layer of cells is a continuous or discontinuous sheet of cells without any separation into test units or wells. The compounds are printed onto a nonabsorbent sheet of porous material as a solution in solvent and allowed to dry. This printed sheet of compounds then defines the test pattern for the experiment as it is brought down in close proximity to or in direct contact with the underlying detector layer of cells. The compounds, now dissolved by the fluid layer on the cells, is brought in contact with the cells through the pores of the membrane by convection. The porous membrane onto which the compounds are printed is optically clear and preferably composed as stated in Appendix I. In another embodiment of this aspect of the present invention the detector layer of cells is a continuous or discontinuous sheet of cells, without any separation into test units or wells, growing on a porous and optically clear

membrane preferably of the types mentioned above. The porous membrane may allow the cells to send cellular processes through the pores of the membrane. The compounds are printed onto an optically clear substratum such as glass, plastic or quartz as solutions in solvent and allowed to dry. At the time of the experiment the cell sheet on the membrane, 5 surrounded by a thin film of fluid, is layered ontop of the printed compound pattern. The compounds then dissolve and contact the cells via diffusion and convection. The compounds may be made using combinatorial chemistry techniques, and may be peptides. The compounds may be covalently attached to the optically clear substratum or porous membrane. The compounds may also be proteins, polypeptides or peptides secreted by or 10 attached to the plasma membrane of genetically modified cells growing as a continuous or discontinuous sheet on a flat optically clear surface or an optically clear porous membrane.

The recording of the variation or result with respect to light emitted from the luminophore is performed by recording the spatially distributed light as one or more digital images, and the processing of the recorded variation to reduce it to one or more numbers representative 15 of the degree of redistribution comprises a digital image processing procedure or combination of digital image processing procedures. The quantitative information which is indicative of the degree of the cellular response to the influence or the result of the influence on the intracellular pathway is extracted from the recording or recordings according to a predetermined calibration based on responses or results, recorded in the 20 same manner, to known degrees of a relevant specific influence. This calibration procedure is developed according to principles described below (Developing an Image-based Assay Technique). Specific descriptions of the procedures for particular assays are given in the examples.

While the stepwise procedure necessary to reduce the image or images to the value 25 representative of the response caused by the influence is particular to each assay, the individual steps are generally well-known methods of image processing. Some examples of the individual steps are point operations such as subtraction, ratioing, and thresholding, digital filtering methods such as smoothing, sharpening, and edge detection, spatial frequency methods such as Fourier filtering, image cross-correlation and image 30 autocorrelation, object finding and classification (blob analysis), and colour space manipulations for visualisation. In addition to the algorithmic procedures, heuristic

methods such as neural networks may also be used. In a preferred embodiment of the invention, a dose-response relationship is established based on quantification of the responses caused by a particular influence, representative of the underlying intracellular signalling process, using the methods described above and in examples 1-22 and 25. The dose-response relationship for the particular influence is then compared to the dose-response relationship obtained by performing the same assay in an instrument which allows parallel monitoring of all wells in a microtiter plate such as a FLIPR™ or an ordinary fluorescence plate reader for microtiter plates. If a good correlation between the dose-response relationships obtained from the two different measurement systems is obtained, it can be said that the parallel measurement mode has been validated (see examples 23 and 24). This implies that it can be used as the primary basis for a screening assay with the potential benefit of screening a significantly higher number of substances per unit of time for their influence on the response.

Imaging plate readers integrate the signal from each well into a single value per time point. Thus the data resulting from a single "run" of the instrument is a set of time series of single values, one for each well, with the injection of the test compound taking place at a known point in the time series. The primary advantage of this type of instrumentation is that it greatly increases the number of samples that can be processed in a given amount of time (the throughput). This is of great advantage when using the assay in a screening program for new pharmaceutical lead compounds.

The first step in the data analysis is to normalise the results from each well so that they can be compared with each other or with previously analysed known compounds. This always begins with correcting the signal by subtracting the instrument bias from all data points on a well-by-well basis. From this point, either of two techniques can be followed depending on the design of the assay:

Procedure 1: The average of the signal prior to the addition of the test compound is subtracted from all data points on a well-by-well basis.

Procedure 2: The data are corrected for any known background by subtracting the background value from all data points on a well-by-well basis. The resulting background-corrected data are normalised by dividing each data set by the average of the data values

prior to the injection of the test compound on a well-by-well basis.

The corrected or normalised time series data sets are then further reduced by a technique that converts the time series to a single value. There are at least three such approaches:

1. For transient responses, the maximum deviation from the baseline is determined. This is also known as the “peak height” technique.
2. Alternatively, the signal is integrated over time between pre-defined limits. If the data were treated according to Procedure 2 above, then the offset is subtracted such that the integral of a non-response is zero within the limit of measurement error. This is also known as the “peak area” technique.
3. If the response is a cumulative one, e.g., an exponential change to a new level, the result is taken as either the difference or the ratio between the signal after a predetermined time and the signal prior to the addition of the test compound.

All of the above procedures reduce the data for a given well to one or more single values. For screening purposes, these values will be searched for those that are greater than a certain statistically determined cut-off value. For characterisation, the values represent a quantitative response, and are further treated in sets by techniques such as dose-response curve fitting.

In another embodiment of the invention, the measurement of redistribution is accomplished indirectly by taking advantage of the fact that in order for redistribution to occur, the probe will experience some change in its freedom, or restriction, of movement within the intracellular milieu. The degree of translocation will correlate with the amount of freely mobile luminophore in the cytoplasm. At a point in time after the test compound has begun to have any influence it may have, the amount or fraction of restricted luminophore can be measured by disrupting or permeabilising the plasma membrane of the cells and allowing the freely mobile luminophore to diffuse away. If the detection volume of the detector is limited to the region immediately surrounding the cells, and the overall volume into which the freely mobile luminophore can diffuse is much larger, then the freely mobile luminophore essentially disappears from the detector’s view and its signal is

not recorded.

In one aspect of the invention, the above mentioned measurement of redistribution is made on cells with permanently permeabilised plasma membranes immersed in a solution mimicking the cytoplasmic environment. In this way the influence of compounds that can  
5 normally not enter the cytoplasm of cells can be tested.

The nucleic acid constructs used in the present invention encode in their nucleic acid sequences fusion polypeptides comprising a biologically active polypeptide that is a component of an intracellular signalling pathway, or a part thereof, and a GFP, preferably an F64L mutant of GFP, N- or C-terminally fused, optionally via a peptide linker, to the  
10 biologically active polypeptide or part thereof.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a protein kinase or a phosphatase.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a transcription factor or a part thereof which changes cellular localisation upon  
15 activation.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a protein, or a part thereof, which is associated with the cytoskeletal network and which changes cellular localisation upon activation.

In one embodiment the biologically active polypeptide encoded by the nucleic acid  
20 construct is a protein kinase or a part thereof which changes cellular localisation upon activation.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a serine/threonine protein kinase or a part thereof capable of changing intracellular localisation upon activation.

25 In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a tyrosine protein kinase or a part thereof capable of changing intracellular localisation upon activation.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a phospholipid-dependent serine/threonine protein kinase or a part thereof capable of changing intracellular localisation upon activation.

5 In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a cAMP-dependent protein kinase or a part thereof capable of changing cellular localisation upon activation. In a preferred embodiment the biologically active polypeptide encoded by the nucleic acid construct is a PKAc-F64L-S65T-GFP fusion.

10 In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a cGMP-dependent protein kinase or a part thereof capable of changing cellular localisation upon activation.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a calmodulin-dependent serine/threonine protein kinase or a part thereof capable of changing cellular localisation upon activation.

15 In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a mitogen-activated serine/threonine protein kinase or a part thereof capable of changing cellular localisation upon activation. In preferred embodiments the biologically active polypeptide encoded by the nucleic acid constructs are an ERK1-F64L-S65T-GFP fusion or an EGFP-ERK1 fusion.

20 In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a cyclin-dependent serine/threonine protein kinase or a part thereof capable of changing cellular localisation upon activation.

In one embodiment the biologically active polypeptide encoded by the nucleic acid construct is a protein phosphatase or a part thereof capable of changing cellular localisation upon activation.

25 In one preferred embodiment of the invention the nucleic acid constructs may be DNA constructs.

In one embodiment the biologically active polypeptide encoded by the nucleic acid



construct. In one embodiment the gene encoding GFP in the nucleic acid construct is derived from *Aequorea victoria*. In a preferred embodiment the gene encoding GFP in the nucleic acid construct is EGFP or a GFP variant selected from F64L-GFP, F64L-Y66H-GFP and F64L-S65T-GFP.

- 5 In preferred embodiments of the invention the DNA constructs which can be identified by any of the DNA sequences shown in SEQ ID NO: 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, and 152 or are variants of these sequences capable of encoding the same fusion polypeptide or a fusion polypeptide which  
10 is biologically equivalent thereto, e.g. an isoform, or a splice variant or a homologue from another species.

- The present invention describes a method that may be used to establish a screening program for the identification of biologically active substances that directly or indirectly affects intracellular signalling pathways and because of this property are potentially useful  
15 as medicaments. Based on measurements in living cells of the redistribution of spatially resolved luminescence from luminophores which undergo a change in distribution upon activation or deactivation of an intracellular signalling pathway the result of the individual measurement of each substance being screened indicates its potential biological activity.

- In one embodiment of the invention the screening program is used for the identification of  
20 a biologically toxic substance as defined herein that exerts its toxic effect by interfering with an intracellular signalling pathway. Based on measurements in living cells of the redistribution of spatially resolved luminescence from luminophores which undergo a change in distribution upon activation or deactivation of an intracellular signalling pathway the result of the individual measurement of each substance being screened  
25 indicates its potential biologically toxic activity. In one embodiment of a screening program a compound that modulates a component of an intracellular pathway as defined herein, can be found and the therapeutic amount of the compound estimated by a method according to the method of the invention. In a preferred embodiment the present invention leads to the discovery of a new way of treating a condition or disease related to the  
30 intracellular function of a biologically active polypeptide comprising administration to a

patient suffering from said condition or disease of an effective amount of a compound which has been discovered by any method according to the invention. In another preferred embodiment of the invention a method is established for identification of a new drug target or several new drug targets among the group of biologically active polypeptides which are components of intracellular signalling pathways.

In another embodiment of the invention an individual treatment regimen is established for the selective treatment of a selected patient suffering from an ailment where the available medicaments used for treatment of the ailment are tested on a relevant primary cell or cells obtained from said patient from one or several tissues, using a method comprising transfecting the cell or cells with at least one DNA sequence encoding a fluorescent probe according to the invention, transferring the transfected cell or cells back the said patient, or culturing the cell or cells under conditions permitting the expression of said probes and exposing it to an array of the available medicaments, then comparing changes in fluorescence patterns or redistribution patterns of the fluorescent probes in the intact living cells to detect the cellular response to the specific medicaments (obtaining a cellular action profile), then selecting one or more medicament or medicaments based on the desired activity and acceptable level of side effects and administering an effective amount of these medicaments to the selected patient.

The present invention describes a method that may be used to establish a screening program for back-tracking signal transduction pathways as defined herein. In one embodiment the screening program is used to establish more precisely at which level one or several compounds affect a specific signal transduction pathway by successively or in parallel testing the influence of the compound or compounds on the redistribution of spatially resolved luminescence from several of the luminophores which undergo a change in distribution upon activation or deactivation of the intracellular signalling pathway under study.

In general, a probe, i.e. a "GeneX"-GFP fusion or a GFP-"GeneX" fusion, is constructed using PCR with "GeneX"-specific primers followed by a cloning step to fuse "GeneX" in frame with GFP. The fusion may contain a short vector derived sequence between "GeneX" and GFP (e.g. part of a multiple cloning site region in the plasmid) resulting in a

peptide linker between “GeneX” and GFP in the resulting fusion protein.

Some of the steps involved in the development of a probe include the following:

- Identify the sequence of the gene. This is most readily done by searching a depository of genetic information, e.g. the GenBank Sequence Database, which is widely  
5 available and routinely used by molecular biologists. In the specific examples below the GenBank Accession number of the gene in question is provided.
- Design the gene-specific primers. Inspection of the sequence of the gene allows design of gene-specific primers to be used in a PCR reaction. Typically, the top-strand primer encompasses the ATG start codon of the gene and the following ca. 20 nucleotides,  
10 while the bottom-strand primer encompasses the stop codon and the ca. 20 preceding nucleotides, if the gene is to be fused behind GFP, i.e. a GFP-“GeneX” fusion. If the gene is to be fused in front of GFP, i.e. a “GeneX”-GFP fusion, a stop codon must be avoided. Optionally, the full-length sequence of GeneX may not be used in the fusion, but merely the part that localizes and redistributes like GeneX in response to a signal.  
15 In addition to gene-specific sequences, the primers contain at least one recognition sequence for a restriction enzyme, to allow subsequent cloning of the PCR product. The sites are chosen so that they are unique in the PCR product and compatible with sites in the cloning vector. Furthermore, it may be necessary to include an exact number of nucleotides between the restriction enzyme site and the gene-specific  
20 sequence in order to establish the correct reading frame of the fusion gene and/or a translation initiation consensus sequence. Lastly, the primers always contain a few nucleotides in front of the restriction enzyme site to allow efficient digestion with the enzyme.
- Identify a source of the gene to be amplified. In order for a PCR reaction to produce a  
25 product with gene-specific primers, the gene-sequence must initially be present in the reaction, e.g. in the form of cDNA. Information in GenBank or the scientific literature will usually indicate in which tissue(s) the gene is expressed, and cDNA libraries from a great variety of tissues or cell types from various species are commercially available, e.g. from Clontech (Palo Alto), Stratagene (La Jolla) and Invitrogen (San Diego).  
30 Many genes are also available in cloned form from The American Type Tissue

Collection (Virginia).

- Optimise the PCR reaction. Several factors are known to influence the efficiency and specificity of a PCR reaction, including the annealing temperature of the primers, the concentration of ions, notably  $Mg^{2+}$  and  $K^+$ , present in the reaction, as well as pH of the reaction. If the result of a PCR reaction is deemed unsatisfactory, it might be because the parameters mentioned above are not optimal. Various annealing temperatures should be tested, e.g. in a PCR machine with a built-in temperature gradient, available from e.g. Stratagene (La Jolla), and/or various buffer compositions should be tried, e.g. the OptiPrime buffer system from Stratagene (La Jolla).
- Clone the PCR product. The vector into which the amplified gene product will be cloned and fused with GFP will already have been taken into consideration when the primers were designed. When choosing a vector, one should at least consider in which cell types the probe subsequently will be expressed, so that the promoter controlling expression of the probe is compatible with the cells. Most expression vectors also contain one or more selective markers, e.g. conferring resistance to a drug, which is a useful feature when one wants to make stable transfectants. The selective marker should also be compatible with the cells to be used.

The actual cloning of the PCR product should present no difficulty as it typically will be a one-step cloning of a fragment digested with two different restriction enzymes into a vector digested with the same two enzymes. If the cloning proves to be problematic, it may be because the restriction enzymes did not work well with the PCR fragment. In this case one could add longer extensions to the end of the primers to overcome a possible difficulty of digestion close to a fragment end, or one could introduce an intermediate cloning step not based on restriction enzyme digestion. Several companies offer systems for this approach, e.g. Invitrogen (San Diego) and Clontech (Palo Alto).

Once the gene has been cloned and, in the process, fused with the GFP gene, the resulting product, usually a plasmid, should be carefully checked to make sure it is as expected. The most exact test would be to obtain the nucleotide sequence of the fusion-gene.

Once a DNA construct for a probe has been generated, its functionality and usefulness may

be evaluated by transfecting it into cells capable of expressing the probe. The fluorescence of the cell is inspected soon after, typically the next day. At this point, two features of cellular fluorescence are noted: the intensity and the sub-cellular localisation.

5 The intensity should usually be at least as strong as that of unfused GFP in the cells. If it is not, the sequence or quality of the probe-DNA might be faulty, and should be carefully checked.

The sub-cellular localisation is an indication of whether the probe is likely to perform well. If it localises as expected for the gene in question, e.g. is excluded from the nucleus, it can immediately go on to a functional test. If the probe is not localised soon after the  
10 transfection procedure, it may be because of overexpression at this point in time, as the cell typically will have taken up very many copies of the plasmid, and localisation will occur in time, e.g. within a few weeks, as plasmid copy number and expression level decreases. If localisation does not occur after prolonged time, it may be because the fusion to GFP has destroyed a localisation function, e.g. masked a protein sequence essential for  
15 interaction with its normal cellular anchor-protein. In this case the opposite fusion might work, e.g. if GeneX-GFP does not work, GFP-GeneX might, as two different parts of GeneX will be affected by the proximity to GFP. If this does not work, the proximity of GFP at either end might be a problem, and it could be attempted to increase the distance by incorporating a longer linker between GeneX and GFP in the DNA construct.

20 If there is no prior knowledge of localisation, and no localisation is observed, it may be because the probe should not be localised at this point, because such is the nature of the protein fused to GFP. It should then be subjected to a functional test.

In a functional test, the cells expressing the probe are treated with at least one compound known to perturb, usually by activating, the signalling pathway on which the probe is  
25 expected to report by redistributing itself within the cell. If the redistribution is as expected, e.g. if prior knowledge tell that it should translocate from location X to location Y, it has passed the first critical test. In this case it can go on to further characterisation and quantification of the response.

If it does not perform as expected, it may be because the cell lacks at least one component

of the signalling pathway, e.g. a cell surface receptor, or there is species incompatibility, e.g. if the probe is modelled on sequence information of a human gene product, and the cell is of hamster origin. In both instances one should identify other cell types for the testing process where these potential problems would not apply.

- 5 If there is no prior knowledge about the pattern of redistribution, the analysis of the redistribution will have to be done in greater depth to identify what the essential and indicative features are, and when this is clear, it can go on to further characterisation and quantification of the response. If no feature of redistribution can be identified, the problem might be as mentioned above, and the probe should be retested under more optimal cellular  
10 conditions.

If the probe does not perform under optimal cellular conditions, then it's back to the drawing board.

- The process of developing an image-based redistribution assay begins with either the unplanned experimental observation that a redistribution phenomenon can be visualised, or  
15 the design of a probe specifically to follow a redistribution phenomenon already known to occur. In either event, the first and best exploratory technique is for a trained scientist or technician to observe the phenomenon. Even with the rapid advances in computing technology, the human eye-brain combination is still the most powerful pattern recognition system known, and requires no advance knowledge of the system in order to detect  
20 potentially interesting and useful patterns in raw data. This is especially if those data are presented in the form of images, which are the natural "data type" for human visual processing. Because human visual processing operates most effectively in a relatively narrow frequency range, i.e., we cannot see either very fast or very slow changes in our visual field, it may be necessary to record the data and play it back with either time  
25 dilation or time compression.

- Some luminescence phenomena cannot be seen directly by the human eye. Examples include polarisation and fluorescence lifetime. However, with suitable filters or detectors, these signals can be recorded as images or sequences of images and displayed to the human in the fashion just described. In this way, patterns can be detected and the same  
30 methods can be applied.

Once the redistribution has been determined to be a reproducible phenomenon, one or more data sets are generated for the purpose of developing a procedure for extracting the quantitative information from the data. In parallel, the biological and optical conditions are determined which will give the best quality raw data for the assay. This can become an  
5 iterative process; it may be necessary to develop a quantitative procedure in order to assess the effect on the assay of manipulating the assay conditions.

The data sets are examined by a person or persons with knowledge of the biological phenomenon and skill in the application of image processing techniques. The goal of this exercise is to determine or at least propose a method that will reduce the image or  
10 sequence of images constituting the record of a “response” to a value corresponding to the degree of the response. Using either interactive image processing software or an image processing toolbox and a programming language, the method is encoded as a procedure or algorithm that takes the image or images as input and generates the degree of response (in any units) as its output. Some of the criteria for evaluating the validity of a particular  
15 procedure are:

- Does the degree of the response vary in a biologically significant fashion, i.e., does it show the known or putative dependence on the concentration of the stimulating agent or condition?
- Is the degree of response reproducible, i.e., does the same concentration or level of  
20 stimulating agent or condition give the same response with an acceptable variance?
- Is the dynamic range of the response sufficient for the purpose of the assay? If not, can a change in the procedure or one of its parameters improve the dynamic range?
- Does the procedure exhibit any clear “pathologies”, i.e., does it give ridiculous values for the response if there are commonly occurring imperfections in the  
25 imaging process? Can these pathologies be eliminated, controlled, or accounted for?
- Can the procedure deal with the normal variation in the number and/or size of cells in an image?

In some cases the method may be obvious; in others, a number of possible procedures may suggest themselves. Even if one method appears clearly superior to others, optimisation of parameters may be required. The various procedures are applied to the data set and the criteria suggested above are determined, or the single procedure is applied repeatedly with  
5 adjustment of the parameter or parameters until the most satisfactory combination of signal, noise, range, etc. are arrived at. This is equivalent to the calibration of any type of single-channel sensor.

The number of ways of extracting a single value from an image are extremely large, and thus an intelligent approach must be taken to the initial step of reducing this number to a  
10 small, finite number of possible procedures. This is not to say that the procedure arrived at is necessarily the best procedure - but a global search for the best procedure is simply out of the question due to the sheer number of possibilities involved.

Image-based assays are no different than other assay techniques in that their usefulness is characterised by parameters such as the specificity for the desired component of the  
15 sample, the dynamic range, the variance, the sensitivity, the concentration range over which the assay will work, and other such parameters. While it is not necessary to characterise each and every one of these before using the assay, they represent the only way to compare one assay with another.

The final step is then to see whether there exists a possibility to increase the throughput of  
20 the assay to improve its utility as the basis of a screening program. In order to do this, a dose-response relationship is established based on quantification of the responses caused by a particular influence, representative of the underlying intracellular signalling process, using the methods described above and in examples 1-22 and 25. The dose-response relationship for the particular influence is then compared to the dose-response relationship  
25 obtained by performing the same assay in an instrument which allows parallel monitoring of all wells in a microtiter plate such as a FLIPR™ or an ordinary imaging or fluorescence plate reader for microtiter plates. If a good correlation between the dose-response relationships obtained from the two different measurement systems is obtained, it can be said that the parallel measurement mode has been validated (see examples 23 and 24). This  
30 implies that it can be used as the primary basis for a screening program with the potential



benefit of screening a significantly higher number of substances for their influence on the response per unit of time.

The process of developing an image-based assay is best illustrated by example. The development of such an assay for GLUT4 translocation is hereby described. GLUT4 is a member of the class of glucose transporter molecules that are important in cellular glucose uptake. It is known to translocate to the plasma membrane under some conditions of stimulation of glucose uptake. The ability to visualise the glucose uptake response non-invasively, without actually measuring glucose uptake, would be a very useful assay for anyone looking for, for example, treatments for type II diabetes.

A CHO cell line which stably expressed the human insulin receptor was used as the basis for a new cell line which stably expressed a fusion between GLUT4 and GFP. This cell line was expected to show translocation of GLUT4 to the plasma membrane as visualised by the movement of the GFP. The translocation could definitely be seen in the form of the appearance of local increases in the fluorescence in regions of the plasma membrane which had a characteristic shape or pattern. This is shown in Figure 12.

These objects became known as “snirclles”, and the phenomenon of their appearance as “snircling”. In order to quantify their appearance, a method had to be found to isolate them as objects in the image field, and then enumerate them, measure their area, or determine some parameter about them which correlated in a dose-dependent fashion with the concentration of insulin to which the cells had been exposed. In order to separate the snirclles, a binarization procedure was applied in which one copy of the image smoothed with a relatively severe gaussian kernel ( $\sigma = 2.5$ ) was subtracted from another copy to which only a relatively light gaussian smooth had been applied ( $\sigma = 0.5$ ). The resultant image was rescaled to its min/max range, and an automatic threshold was applied to divide the image into two levels. The thresholded image contains a background of one value all found object with another value. The found objects were first filtered through a filter to remove objects far too large and far too small to be snirclles. The remaining objects, which represent snirclles and other artifacts from the image with approximately the same size and intensity characteristics as snirclles, are passed into a classification procedure which has been previously trained with many images of snirclles to recognize snirclles and exclude the

other artifacts. The result of this procedure is a binary image that shows only the round snirclles to the degree to which the classification procedure can accurately identify them. The total area of the snirclles is then summed and this value is the quantitative measure of the degree of snircling for that image.

5 Another approach to the problem of quantifying GLUT 4 translocation has been performed and validated using the same type of experimental protocol but a different image processing approach. In this case the objects of interest in the cells are not the appearance of snirclles at the plasma membrane but the disappearance of GLUT4-GFP fluorescence from its intracellular site. With this method the bright area, consisting of GLUT4-GFP,  
10 centrally located in each cell is identified by a thresholding procedure. This demarcates a certain area for the centrally located GLUT4-GFP. In the next step the total fluorescence intensity in this area is quantified on each image in the image series, i.e. over time. The response for each cell is defined as the difference in fluorescence intensity in the centrally located GLUT4-GFP area before and a fixed point in time after application of the  
15 influence. The dose-response relationship for insulin using the above described quantitation procedure is shown in Figure 13. It can be seen that the ED50 value for insulin to reduce central GLUT4-GFP fluorescence is 0.3 nM.

In the present specification and claims, the term "an influence" covers any influence to which the cellular response comprises a redistribution. Thus, e.g., heating, cooling, high  
20 pressure, low pressure, humidifying, or drying are influences on the cellular response on which the resulting redistribution can be quantified, but as mentioned above, perhaps the most important influences are the influences of contacting or incubating the cells with substances which are known or suspected to exert an influence on the cellular response involving a redistribution contribution. In another embodiment of the invention the  
25 influence could be substances from a compound drug library.

In the present context, the term "green fluorescent protein" is intended to indicate a protein which, when expressed by a cell, emits fluorescence upon exposure to light of the correct excitation wavelength (cf. [(Chalfie, M. *et al.* (1994) *Science* 263, 802-805)]). In the following, GFP in which one or more amino acids have been substituted, inserted or  
30 deleted is most often termed "modified GFP". "GFP" as used herein includes wild-type

GFP derived from the jelly fish *Aequorea victoria* and modifications of GFP, such as the blue fluorescent variant of GFP disclosed by Heim *et al.* (1994). Proc.Natl.Acad.Sci. 91:26, pp 12501-12504, and other modifications that change the spectral properties of the GFP fluorescence, or modifications that exhibit increased fluorescence when expressed in cells at a temperature above about 30°C described in PCT/DK96/00051, published as WO 97/11094 on 27 March 1997 and hereby incorporated by reference, and which comprises a fluorescent protein derived from *Aequorea* Green Fluorescent Protein (GFP) or any functional analogue thereof, wherein the amino acid in position 1 upstream from the chromophore has been mutated to provide an increase of fluorescence intensity when the fluorescent protein of the invention is expressed in cells. Preferred GFP variants are F64L-GFP, F64L-Y66H-GFP and F64L-S65T-GFP. An especially preferred variant of GFP for use in all the aspects of this invention is EGFP (DNA encoding EGFP which is a F64L-S65T variant with codons optimized for expression in mammalian cells is available from Clontech, Palo Alto, plasmids containing the EGFP DNA sequence, cf. GenBank Acc. Nos. U55762, U55763).

The term “intracellular signalling pathway” and “signal transduction pathway” are intended to indicate the co-ordinated intracellular processes whereby a living cell transduce an external or internal signal into cellular responses. Said signal transduction will involve an enzymatic reaction said enzymes include but are not limited to protein kinases, GTPases, ATPases, protein phosphatases, phospholipases and cyclic nucleotide phosphodiesterases. The cellular responses include but are not limited to gene transcription, secretion, proliferation, mechanical activity, metabolic activity, cell death.

The term “second messenger” is used to indicate a low molecular weight component involved in the early events of intracellular signal transduction pathways.

The term “luminophore” is used to indicate a chemical substance that has the property of emitting light either inherently or upon stimulation with chemical or physical means. This includes but is not limited to fluorescence, bioluminescence, phosphorescence, and chemiluminescence.

The term “mechanically intact living cell” is used to indicate a cell which is considered living according to standard criteria for that particular type of cell such as maintenance of normal membrane potential, energy metabolism, proliferative capability, and has not

experienced any physically invasive treatment designed to introduce external substances into the cell such as microinjection.

In the present context, the term “permeabilised living cell” is used to indicate cells where a pore forming agent such as Streptolysin O or *Staphylococcus Aureus*  $\alpha$ -toxin has been applied and thereby incorporated into the plasma membrane in the cells. This creates proteinaceous pores with a defined pore size in the plasma membranes of the exposed cells. Pores could also be made by electroporation, i.e. exposing the cells to high voltage discharges, a procedure that creates small holes in the plasma membrane by coagulating integral membrane proteins. Treatment with a mild detergent such as saponin may accomplish the same thing. Common to all these treatments are that pores are formed only in the plasma membrane without affecting the integrity of cytoplasmic structural elements and organelles. The term living in this context means that the permeabilised cells bathed in a solution mimicking the intracellular milieu still have functional organelles, such as actively respiring mitochondria and endoplasmic reticulum that can take up and release calcium ions, and functional structural elements. The benefit of this method is that substances that normally can not traverse the plasma membrane, but most likely exert their influence intracellularly, can be introduced and their influence studied without cumbersome microinjection of the substances into single cells. Using this method the response to an influence can be recorded from many cells simultaneously.

In the present context, the term “permeabilisation” is intended to indicate the selective disruption of the plasma membrane barrier so that soluble substances freely mobile in the cytosol are lost from the cells. The permeabilisation can be achieved as described above under “permeabilised living cells” or by using other chemical detergents such as Triton X-100 or digitonin in carefully titrated amounts.

The term “physiologically relevant”, when applied to an experimentally determined redistribution of an intracellular component, as measured by a change in the luminescence properties or distribution, is used to indicate that said redistribution can be explained in terms of the underlying biological phenomenon which gives rise to the redistribution.

The terms “image processing” and “image analysis” are used to describe a large family of digital data analysis techniques or combination of such techniques which reduce ordered

arrays of numbers (images) to quantitative information describing those ordered arrays of numbers. When said ordered arrays of numbers represent measured values from a physical process, the quantitative information derived is therefore a measure of the physical process.

- 5 The term “fluorescent probe” is used to indicate a fluorescent fusion polypeptide comprising a GFP or any functional part thereof which is N- or C-terminally fused to a biologically active polypeptide as defined herein, optionally via a peptide linker consisting of one or more amino acid residues, where the size of the linker peptide in itself is not critical as long as the desired functionality of the fluorescent probe is maintained. A  
10 fluorescent probe according to the invention is expressed in a cell and basically mimics the physiological behaviour of the biologically active polypeptide moiety of the fusion polypeptide.

The term “mammalian cell” is intended to indicate any living cell of mammalian origin. The cell may be an established cell line, many of which are available from The American  
15 Type Culture Collection (ATCC, Virginia, USA) or a primary cell with a limited life span derived from a mammalian tissue, including tissues derived from a transgenic animal, or a newly established immortal cell line derived from a mammalian tissue including transgenic tissues, or a hybrid cell or cell line derived by fusing different cell types of mammalian origin e.g. hybridoma cell lines. The cells may optionally express one or more  
20 non-native gene products, e.g. receptors, enzymes, enzyme substrates, prior to or in addition to the fluorescent probe. Preferred cell lines include but are not limited to those of fibroblast origin, e.g. BHK, CHO, BALB, or of endothelial origin, e.g. HUVEC, BAE (bovine artery endothelial), CPAE (cow pulmonary artery endothelial), HLMVEC (human lung microvascular endothelial cells) or of pancreatic origin, e.g. RIN, INS-1, MIN6,  
25 bTC3, aTC6, bTC6, HIT, or of hematopoietic origin, e.g. primary isolated human monocytes, macrophages, neutrophils, basophils, eosinophils and lymphocyte populations, AML-193, HL-60, RBL-1, adipocyte origin, e.g. 3T3-L1, neuronal/neuroendocrine origin, e.g. AtT20, PC12, GH3, muscle origin, e.g. SKMC, A10, C2C12, renal origin, e.g. HEK 293, LLC-PK1.

- 30 The term “hybrid polypeptide” is intended to indicate a polypeptide which is a fusion of at

least a portion of each of two proteins, in this case at least a portion of the green fluorescent protein, and at least a portion of a catalytic and/or regulatory domain of a protein kinase. Furthermore a hybrid polypeptide is intended to indicate a fusion polypeptide comprising a GFP or at least a portion of the green fluorescent protein that contains a functional fluorophore, and at least a portion of a biologically active polypeptide as defined herein provided that said fusion is not the PKC $\alpha$ -GFP, PKC $\gamma$ -GFP, and PKC $\epsilon$ -GFP disclosed by Schmidt *et al.* and Sakai *et al.*, respectively. Thus, GFP may be N- or C-terminally tagged to a biologically active polypeptide, optionally via a linker portion or linker peptide consisting of a sequence of one or more amino acids. The hybrid polypeptide or fusion polypeptide may act as a fluorescent probe in intact living cells carrying a DNA sequence encoding the hybrid polypeptide under conditions permitting expression of said hybrid polypeptide.

The term “kinase” is intended to indicate an enzyme that is capable of phosphorylating a cellular component.

The term “protein kinase” is intended to indicate an enzyme that is capable of phosphorylating serine and/or threonine and/or tyrosine in peptides and/or proteins.

The term “phosphatase” is intended to indicate an enzyme that is capable of dephosphorylating phosphoserine and/or phosphothreonine and/or phosphotyrosine in peptides and/or proteins.

The term “cyclic nucleotide phosphodiesterase” is intended to indicate an enzyme that is capable of inactivating the second messengers cAMP and cGMP by hydrolysis of their 3'-ester bond.

In the present context, the term “biologically active polypeptide” is intended to indicate a polypeptide affecting intracellular processes upon activation, such as an enzyme which is active in intracellular processes or a portion thereof comprising a desired amino acid sequence which has a biological function or exerts a biological effect in a cellular system. In the polypeptide one or several amino acids may have been deleted, inserted or replaced to alter its biological function, e.g. by rendering a catalytic site inactive. Preferably, the biologically active polypeptide is selected from the group consisting of proteins taking part

in an intracellular signalling pathway, such as enzymes involved in the intracellular phosphorylation and dephosphorylation processes including kinases, protein kinases and phosphorylases as defined herein, but also proteins making up the cytoskeleton play important roles in intracellular signal transduction and are therefore included in the meaning of “biologically active polypeptide” herein. More preferably, the biologically active polypeptide is a protein which according to its state as activated or non-activated changes localisation within the cell, preferably as an intermediary component in a signal transduction pathway. Included in this preferred group of biologically active polypeptides are cAMP dependent protein kinase A.

The term “a substance having biological activity” is intended to indicate any sample that has a biological function or exerts a biological effect in a cellular system. The sample may be a sample of a biological material such as a sample of a body fluid including blood, plasma, saliva, milk, urine, or a microbial or plant extract, an environmental sample containing pollutants including heavy metals or toxins, or it may be a sample containing a compound or mixture of compounds prepared by organic synthesis or genetic techniques.

The phrase “any change in fluorescence” means any change in absorption properties, such as wavelength and intensity, or any change in spectral properties of the emitted light, such as a change of wavelength, fluorescence lifetime, intensity or polarisation, or any change in the intracellular localisation of the fluorophore. It may thus be localised to a specific cellular component (e.g. organelle, membrane, cytoskeleton, molecular structure) or it may be evenly distributed throughout the cell or parts of the cell.

The term “organism” as used herein indicates any unicellular or multicellular organism preferably originating from the animal kingdom including protozoans, but also organisms that are members of the plant kingdoms, such as algae, fungi, bryophytes, and vascular plants are included in this definition.

The term “nucleic acid” is intended to indicate any type of poly- or oligonucleic acid sequence, such as a DNA sequence, a cDNA sequence, or an RNA sequence.

The term “biologically equivalent” as it relates to proteins is intended to mean that a first protein is equivalent to a second protein if the cellular functions of the two proteins may

substitute for each other, e.g. if the two proteins are closely related isoforms encoded by different genes, if they are splicing variants, or allelic variants derived from the same gene, if they perform identical cellular functions in different cell types, or in different species.

The term “biologically equivalent” as it relates to DNA is intended to mean that a first  
5 DNA sequence encoding a polypeptide is equivalent to a second DNA sequence encoding a polypeptide if the functional proteins encoded by the two genes are biologically equivalent.

The phrase “back-tracking of a signal transduction pathway” is intended to indicate a process for defining more precisely at what level a signal transduction pathway is affected,  
10 either by the influence of chemical compounds or a disease state in an organism. Consider a specific signal transduction pathway represented by the bioactive polypeptides A - B - C - D, with signal transduction from A towards D. When investigating all components of this signal transduction pathway compounds or disease states that influence the activity or redistribution of only D can be considered to act on C or downstream of C whereas  
15 compounds or disease states that influence the activity or redistribution of C and D, but not of A and B can be considered to act downstream of B.

The term “fixed cells” is used to mean cells treated with a cytological fixative such as glutaraldehyde or formaldehyde, treatments that serve to chemically cross-link and stabilise soluble and insoluble proteins within the structure of the cell. Once in this state,  
20 such proteins cannot be lost from the structure of the now-dead cell.

In the present context a “screening assay” is intended to mean any measurement protocol, including materials, cells, instruments, chemicals, reagents, detection units, calibration and quantification procedures used to measure a response from mechanically intact or permeabilised living cells relevant to influences on an intracellular pathway.

25 The term “dose-response relationship” and “screening programme” is in the present context intended to mean a clear correlation between the quantified response of cells in a screening assay to application of an influence, such as a compound, and the concentration of the applied influence. The response to the influence may be both an up-regulation and a down-regulation of the quantified parameter used in the screening assay.



In the present context, the term “physiology” is intended to mean the normal function of biological and biochemical processes inside cells, between cells and in the whole organism or animal.

## 5 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1. CHO cells expressing the PKAc-F64L-S65T-GFP hybrid protein have been treated in HAM's F12 medium with 50  $\mu$ M forskolin at 37°C. The images of the GFP fluorescence in these cells have been taken at different time intervals after treatment, which were: a) 40 seconds b) 60 seconds c) 70 seconds d) 80 seconds. The fluorescence  
10 changes from a punctate to a more even distribution within the (non-nuclear) cytoplasm.

Figure 2. Time-lapse analysis of forskolin induced PKAc-F64L-S65T-GFP redistribution. CHO cells, expressing the PKAc-F64L-S65T-GFP fusion protein were analysed by time-lapse fluorescence microscopy. Fluorescence micrographs were acquired at regular  
15 intervals from 2 min before to 8 min after the addition of agonist. The cells were challenged with 1  $\mu$ M forskolin immediately after the upper left image was acquired ( $t=0$ ). Frames were collected at the following times: i) 0, ii) 1, iii) 2, iv) 3, v) 4 and vi) 5 minutes. Scale bar 10  $\mu$ m.

20 Figure 3. Time-lapse analyses of PKAc-F64L-S65T-GFP redistribution in response to various agonists. The effects of 1  $\mu$ M forskolin (A), 50  $\mu$ M forskolin (B), 1mM dbcAMP (C) and 100  $\mu$ M IBMX (D) (additions indicated by open arrows) on the localisation of the PKAc-F64L-S65T-GFP fusion protein were analysed by time-lapse fluorescence microscopy of CHO/PKAc-F64L-S65T-GFP cells. The effect of addition of 10  $\mu$ M  
25 forskolin (open arrow), followed shortly by repeated washing with buffer (solid arrow), on the localisation of the PKAc-F64L-S65T-GFP fusion protein was analysed in the same cells (E). In a parallel experiment, the effect of adding 10  $\mu$ M forskolin and 100  $\mu$ M IBMX (open arrow) followed by repeated washing with buffer containing 100  $\mu$ M IBMX

(solid arrow) was analysed (F). Removing forskolin caused PKAc-F64L-S65T-GFP fusion protein to return to the cytoplasmic aggregates while this is prevented by the continued presence of IBMX (F). The effect of 100 nM glucagon (Fig 3G, open arrow) on the localisation of the PKAc-F64L-S65T-GFP fusion protein is also shown for BHK/GR, PKAc-F64L-S65T-GFP cells. The effect of 10  $\mu$ M norepinephrine (H), solid arrow, on the localisation of the PKAc-F64L-S65T-GFP fusion protein was analysed similarly, in transiently transfected CHO, PKAc-F64L-S65T-GFP cells, pretreated with 10  $\mu$ M forskolin, open arrow, to increase [cAMP]. N.B. in Fig 3H the x-axis counts the image numbers, with 12 seconds between images. The raw data of each experiment consisted of 60 fluorescence micrographs acquired at regular intervals including several images acquired before the addition of buffer or agonist. The charts (A-G) each show a quantification of the response seen through all the 60 images, performed as described in analysis method 2. The change in total area of the highly fluorescent aggregates, relative to the initial area of fluorescent aggregates is plotted as the ordinate in all graphs in Figure 3, versus time for each experiment. Scale bar 10  $\mu$ m.

Figure 4. Dose-response curve (two experiments) for forskolin-induced redistribution of the PKAc-F64L-S65T-GFP fusion.

Figure 5. Time from initiation of a response to half maximal ( $t_{1/2max}$ ) and maximal ( $t_{max}$ ) PKAc-F64L-S65T-GFP redistribution. The data was extracted from curves such as that shown in "Figure 2." All  $t_{1/2max}$  and  $t_{max}$  values are given as mean $\pm$ SD and are based on a total of 26-30 cells from 2-3 independent experiments for each forskolin concentration. Since the observed redistribution is sustained over time, the  $t_{max}$  values were taken as the earliest time point at which complete redistribution is reached. Note that the values do not relate to the degree of redistribution.

Figure 6. Parallel dose-response analyses of forskolin induced cAMP elevation and PKAc-

F64L-S65T-GFP redistribution. The effects of buffer or 5 increasing concentrations of forskolin on the localisation of the PKAc-F64L-S65T-GFP fusion protein in CHO/PKAc-F64L-S65T-GFP cells, grown in a 96 well plate, were analysed as described above. Computing the ratio of the SD's of fluorescence micrographs taken of the same field of  
5 cells, prior to and 30 min after the addition of forskolin, gave a reproducible measure of PKAc-F64L-S65T-GFP redistribution. The graph shows the individual 48 measurements and a trace of their mean  $\pm$  s.e.m at each forskolin concentration. For comparison, the effects of buffer or 8 increasing concentrations of forskolin on [cAMP]<sub>i</sub> was analysed by a scintillation proximity assay of cells grown under the same conditions. The graph shows a  
10 trace of the mean  $\pm$  s.e.m of 4 experiments expressed in arbitrary units.

Figure 7. BHK cells stably transfected with the human muscarinic (hM1) receptor and the PKC $\alpha$ -F64L-S65T-GFP fusion. Carbachol (100  $\mu$ M added at 1.0 second) induced a transient redistribution of PKC $\alpha$ -F64L-S65T-GFP from the cytoplasm to the plasma  
15 membrane. Images were taken at the following times: a) 1 second before carbachol addition, b) 8.8 seconds after addition and c) 52.8 seconds after addition.

Figure 8. BHK cells stably transfected with the hM1 receptor and PKC $\alpha$ -F64L-S65T-GFP fusion were treated with carbachol (1  $\mu$ M, 10  $\mu$ M, 100  $\mu$ M). In single cells intracellular  
20 [Ca<sup>2+</sup>] was monitored simultaneously with the redistribution of PKC $\alpha$ -F64L-S65T-GFP. Dashed line indicates the addition times of carbachol. The top panel shows changes in the intracellular Ca<sup>2+</sup> concentration of individual cells with time for each treatment. The middle panel shows changes in the average cytoplasmic GFP fluorescence for individual cells against time for each treatment. The bottom panel shows changes in the fluorescence  
25 of the periphery of single cells, within regions that specifically include the circumferential edge of a cell as seen in normal projection, the best regions for monitoring changes in the fluorescence intensity of the plasma membrane.

- a) The hERK1-F64L-S65T-GFP fusion expressed in HEK293 cells treated with 100  $\mu$ M of the MEK1 inhibitor PD98059 in HAM F-12 (without serum) for 30 minutes at 37  $^{\circ}$ C. The nuclei empty of fluorescence during this treatment.
- 5 b) The same cells as in (a) following treatment with 10 % foetal calf serum for 15 minutes at 37  $^{\circ}$ C.
- c) Time profiles for the redistribution of GFP fluorescence in HEK293 cells following treatment with various concentrations of EGF in Hepes buffer (HAM F-12 replaced with Hepes buffer directly before the experiment). Redistribution of fluorescence is expressed as the change in the ratio value between areas in nucleus and cytoplasm of  
10 single cells. Each time profile is the mean for the changes seen in six single cells.
- d) Bar chart for the end-point measurements, 600 seconds after start of EGF treatments, of fluorescence change (nucleus:cytoplasm) following various concentrations of EGF.

15 Figure 10.

- a) The SMAD2-EGFP fusion expressed in HEK293 cells starved of serum overnight in HAM F-12. HAM F-12 was then replaced with Hepes buffer pH 7.2 immediately before the experiment. Scale bar is 10  $\mu$ m.
- b) HEK 293 cells expressing the SMAD2-EGFP fusion were treated with various  
20 concentration of TGF-beta as indicated, and the redistribution of fluorescence monitored against time. The time profile plots represent increases in fluorescence within the nucleus, normalised to starting values in each cell measured. Each trace is the time profile for a single cell nucleus.
- c) A bar chart representing the end-point change in fluorescence within nuclei (after 850  
25 seconds of treatment) for different concentrations of TGF-beta. Each bar is the value for a single nucleus in each treatment.

Figure 11. The VASP-F64L-S65T-GFP fusion in CHO cells stably transfected with the human insulin receptor. The cells were starved for two hours in HAM F-12 without serum, then treated with 10% foetal calf serum. The image shows the resulting redistribution of fluorescence after 15 minutes of treatment. GFP fluorescence becomes localised in structures identified as focal adhesions along the length of actin stress fibres.

Figure 12. Time lapse recording GLUT4-GFP redistribution in CHO-HIR cells. Time indicates minutes after the addition of 100 nM insulin.

10

Figure 13. Dose-response relationships for the influence of insulin on the disappearance of total fluorescence from the centrally located area of GLUT4-GFP. Data points indicate mean $\pm$ SE.

15 Figure 14. Dose-response relationship for the translocation of PKC $\alpha$ -GFP in BHKhM1 cells stimulated with the muscarinic agonist carbamylcholine using a FLIPR<sup>TM</sup> to do the actual experiments.

Figure 15. Dose-response relationship for the translocation of PKAc-GFP in CHO/PKAc-F64L-S65T-GFP cells stimulated with forskolin using a FLIPR<sup>TM</sup> to do the actual experiments.

20 Figure 16. Dose-response relationship for the disappearance of fluorescence from permeabilised CHO/PKAc-F64L-S65T-GFP when previously exposed to different doses of forskolin.

25



## EXAMPLES

### EXAMPLE 1

#### **Construction, testing and implementation of an assay for cAMP based on PKA activation in real time within living cells.**

Useful for monitoring the activity of signalling pathways that lead to altered concentrations of cAMP, e.g. activation of G-protein coupled receptors which couple to G-proteins of the  $G_s$  or  $G_i$  class.

The catalytic subunit of the murine cAMP dependent protein kinase (PKAc) was fused C-terminally to a F64L-S65T derivative of GFP. The resulting fusion (PKAc-F64L-S65T-GFP) was used for monitoring *in vivo* the translocation and thereby the activation of PKA.

To construct the PKAc-F64L-S65T-GFP fusion, convenient restriction endonuclease sites were introduced into the cDNAs encoding murine PKAc (Gen Bank Accession number: M12303) and F64L-S65T-GFP (sequence disclosed in WO 97/11094) by polymerase chain reaction (PCR). The PCR reactions were performed according to standard protocols with the following primers:

5'PKAc:

TTggACACAAGCTTTggACACCCTCaggATATgggCAACgCCgCCgCCgCCAAG (SEQ ID NO:3),

3'PKAc:

gTCATCTTCTCgAgTCTTTCaggCgCgCCCAAAGTCgTAAACTCCTTgCCACAC (SEQ ID NO:4) ,

5'GFP: TTggACACAAGCTTTggACACggCgCgCCATgAgTAAaggAgAAgAACTTTTC (SEQ ID NO:1),

3'GFP: gTCATCTTCTCgAgTCTTACTCCTgAggTTTgTATAgTTCATCCATgCCATgT (SEQ ID NO:2).

The PKAc amplification product was then digested with HindIII+AscI and the F64L-S65T-GFP product with AscI+XhoI. The two digested PCR products were subsequently ligated with a HindIII+XhoI digested plasmid (pZeoSV® mammalian expression vector, Invitrogen, San Diego, CA, USA). The resulting fusion construct (SEQ ID NO:68 & 69) was under control of the SV40 promoter.

#### Transfection and cell culture conditions:

Chinese hamster ovary cells (CHO), were transfected with the plasmid containing the PKAc-F64L-S65T-GFP fusion using the calcium phosphate precipitate method in HEPES-buffered saline (Sambrook *et al.*, 1989). Stable transfectants were selected using 1000 µg Zeocin/ml (Invitrogen) in the growth medium (DMEM with 1000 mg glucose/l, 10 % fetal bovine serum (FBS), 100 µg penicillin-streptomycin mixture ml<sup>-1</sup>, 2 mM L-glutamine purchased from Life Technologies Inc., Gaithersburg, MD, USA). Untransfected CHO cells were used as the control. To assess the effect of glucagon on fusion protein translocation, the PKAc-F64L-S65T-GFP fusion was stably expressed in baby hamster kidney cells overexpressing the human glucagon receptor (BHK/GR cells). Untransfected BHK/GR cells were used as the control. Expression of GR was maintained with 500 µg G418/ml (*Neo* marker) and PKAc-F64L-S65T-GFP was maintained with 500 µg Zeocin/ml (*Sh ble* marker). CHO cells were also simultaneously co-transfected with vectors containing the PKAc-F64L-S65T-GFP fusion and the human α2a adrenoceptor (hARα2a).

For fluorescence microscopy, cells were allowed to adhere to Lab-Tek chambered coverglasses (Nalge Nunc Int., Naperville, IL, USA) for at least 24 hours and cultured to about 80% confluence. Prior to experiments, the cells were cultured over night without selection pressure in HAM F-12 medium with glutamax (Life Technologies), 100 µg penicillin-streptomycin mixture ml<sup>-1</sup> and 0.3 % FBS. This medium has low autofluorescence enabling fluorescence microscopy of cells straight from the incubator.

#### Monitoring activity of PKA activity in real time:



Image acquisition of live cells were gathered using a Zeiss Axiovert 135M fluorescence microscope fitted with a Fluar 40X, NA: 1.3 oil immersion objective and coupled to a Photometrics CH250 charged coupled device (CCD) camera. The cells were illuminated with a 100 W HBO arc lamp. In the light path was a  $470\pm 20$  nm excitation filter, a 510 nm dichroic mirror and a  $515\pm 15$  nm emission filter for minimal image background. The cells were maintained at  $37^{\circ}\text{C}$  with a custom built stage heater.

Images were processed and analysed in the following manner:

Method 1: Stepwise procedure for quantitation of translocation of PKA:

1. The image was corrected for dark current by performing a pixel-by-pixel subtraction of a dark image (an image taken under the same conditions as the actual image, except the camera shutter is not allowed to open).
2. The image was corrected for non-uniformity of the illumination by performing a pixel-by-pixel ratio with a flat field correction image (an image taken under the same conditions as the actual image of a uniformly fluorescent specimen).
3. The image histogram, i.e., the frequency of occurrence of each intensity value in the image, was calculated.
4. A smoothed, second derivative of the histogram was calculated and the second zero is determined. This zero corresponds to the inflection point of the histogram on the high side of the main peak representing the bulk of the image pixel values.
5. The value determined in step 4 was subtracted from the image. All negative values were discarded.
6. The variance (square of the standard deviation) of the remaining pixel values was determined. This value represents the “response” for that image.
7. Scintillation proximity assay (SPA) for independent quantitation of cAMP.

Method 2: Alternative method for quantitation of PKA redistribution:

1. The fluorescent aggregates are segmented from each image using an automatically found threshold based on the maximisation of the information measure between the object and background. The *a priori* entropy of the image histogram is used as the information measure.
- 5 2. The area of each image occupied by the aggregates is calculated by counting pixels in the segmented areas.
3. The value obtained in step 2 for each image in a series, or treatment pair, is normalised to the value found for the first (unstimulated) image collected. A value of zero (0) indicates no redistribution of fluorescence from the starting condition. A value of one  
10 (1) by this method equals full redistribution.

Cells were cultured in HAM F-12 medium as described above, but in 96-well plates. The medium was exchanged with  $\text{Ca}^{2+}$ -HEPES buffer including 100  $\mu\text{M}$  IBMX and the cells were stimulated with different concentrations of forskolin for 10 min. Reactions were stopped with addition of NaOH to 0.14 M and the amount of cAMP produced was  
15 measured with the cAMP-SPA kit, RPA538 (Amersham) as described by the manufacturer.

Manipulating intracellular levels of cAMP to test the PKAc-F64L-S65T-GFP fusion.

The following compounds were used to vary cAMP levels: Forskolin, an activator of  
20 adenylate cyclase; dbcAMP, a membrane permeable cAMP analog which is not degraded by phosphodiesterase; IBMX, an inhibitor of phosphodiesterase.

CHO cells stably expressing the PKAc-F64L-S65T-GFP, showed a dramatic translocation of the fusion protein from a punctate distribution to an even distribution throughout the cytoplasm following stimulation with 1  $\mu\text{M}$  forskolin (n=3), 10  $\mu\text{M}$  forskolin (n=4) and  
25 50  $\mu\text{M}$  forskolin (n=4) (Fig 1), or dbcAMP at 1mM (n=6).

Fig. 2 shows the progression of response in time following treatment with 1  $\mu\text{M}$  forskolin.

Fig. 3 gives a comparison of the average temporal profiles of fusion protein redistribution and a measure of the extent of each response to the three forskolin concentrations (Fig. 3A, E, B), and to 1 mM dbcAMP (fig 3C) which caused a similar but slower response, and to addition of 100  $\mu$ M IBMX (n=4, Fig. 3D) which also caused a slow response, even in the  
5 absence of adenylate cyclase stimulation. Addition of buffer (n=2) had no effect (data not shown).

As a control for the behaviour of the fusion protein, F64L-S65T-GFP alone was expressed in CHO cells and these were also given 50  $\mu$ M forskolin (n=5); the uniform diffuse  
10 distribution characteristic of GFP in these cells was unaffected by such treatment (data not shown).

The forskolin-induced translocation of PKAc-F64L-S65T-GFP showed a dose-response relationship (Fig 4 and 6), see quantitative procedures above.

#### Reversibility of PKAc-F64L-S65T-GFP translocation.

15 The release of the PKAc probe from its cytoplasmic anchoring hotspots was reversible. Washing the cells repeatedly (5-8 times) with buffer after 10 $\mu$ M forskolin treatment completely restored the punctate pattern within 2-5 min (n=2, Fig. 3E). In fact the fusion protein returned to a pattern of fluorescent cytoplasmic aggregates virtually indistinguishable from that observed before forskolin stimulation.

20 To test whether the return of fusion protein to the cytoplasmic aggregates reflected a decreased [cAMP]<sub>i</sub>, cells were treated with a combination of 10  $\mu$ M forskolin and 100  $\mu$ M IBMX (n=2) then washed repeatedly (5-8 times) with buffer containing 100  $\mu$ M IBMX (Fig. 3F). In these experiments, the fusion protein did not return to its prestimulatory localisation after removal of forskolin.

25

Testing the PKA-F64L-S65T-GFP probe with physiologically relevant agents.

- To test the probe's response to receptor activation of adenylate cyclase, BHK cells stably transfected with the glucagon receptor and the PKA-F64L-S65T-GFP probe were exposed to glucagon stimulation. The glucagon receptor is coupled to a  $G_s$  protein which activates adenylate cyclase, thereby increasing the cAMP level. In these cells, addition of 100 nM glucagon (n=2) caused the release of the PKA-F64L-S65T-GFP probe from the cytoplasmic aggregates and a resulting translocation of the fusion protein to a more even cytoplasmic distribution within 2-3 min (Fig. 3G). Similar but less pronounced effects were seen at lower glucagon concentrations (n=2, data not shown). Addition of buffer (n=2) had no effect over time (data not shown).
- Transiently transfected CHO cells expressing hAR $\alpha$ 2a and the PKA-F64L-S65T-GFP probe were treated with 10  $\mu$ M forskolin for 7.5 minutes, then, in the continued presence of forskolin, exposed to 10  $\mu$ M norepinephrine to stimulate the exogenous adrenoreceptors, which couple to a  $G_i$  protein, which inhibit adenylate cyclase. This treatment led to reappearance of fluorescence in the cytoplasmic aggregates indicative of a decrease in [cAMP]<sub>i</sub> (Fig. 3H).

#### Fusion protein translocation correlated with [cAMP]<sub>i</sub>

- As described above, the time it took for a response to come to completion was dependent on the forskolin dose (Fig. 5) In addition the degree of responses was also dose-dependent.
- To test the PKA-F64L-S65T-GFP fusion protein translocation in a semi high through-put system, CHO cells stably transfected with the PKA-F64L-S65T-GFP fusion was stimulated with buffer and 5 increasing doses of forskolin (n=8). Using the image analysis algorithm described above (Method 1), a dose-response relationship was observed in the range from 0.01-50  $\mu$ M forskolin (Fig. 6). A half-maximal stimulation was observed at about 2  $\mu$ M forskolin. In parallel, cells were stimulated with buffer and 8 increasing concentrations of forskolin (n=4) in the range 0.01-50  $\mu$ M. The amount of cAMP produced was measured in an SPA assay. A steep increase was observed between 1 and 5  $\mu$ M forskolin coincident with the steepest part of the curve for fusion protein translocation (also Fig. 6).

## EXAMPLE 2

### **Quantitation of redistribution in real-time within living cells.**

Probe for detection of PKC activity in real time within living cells:

5    **Construction of PKC-GFP fusion:**

The probe was constructed by ligating two restriction enzyme treated polymerase chain reaction (PCR) amplification products of the cDNA for murine PKC $\alpha$  (GenBank Accession number: M25811) and F64L-S65T-GFP (sequence disclosed in WO 97/11094) respectively. Taq® polymerase and the following oligonucleotide primers were used for  
10    PCR;

5'mPKC $\alpha$ :

TTggACACAAgCTTTggACACCCTCAggATATggCTgACgTTTACCCggCCAACg  
(SEQ ID NO:5),

3'mPKC $\alpha$ :

15    gTCATCTTCTCgAgTCTTTCAggCgCgCCCTACTgCACTTTgCAAgATTgggTgC (SEQ  
ID NO:6),

5'F64L-S65T-GFP:

TTggACACAAgCTTTggACACggCgCgCCATgAgTAAAggAgAAgAACTTTTC (SEQ  
ID NO:1),

20    3'F64L-S65T-GFP:

gTCATCTTCTCgAgTCTTACTCCTgAggTTTgTATAgTTCATCCATgCCATgT (SEQ  
ID NO:2).

The hybrid DNA strand was inserted into the pZeoSV® mammalian expression vector as a HindIII-XhoI cassette as described in example 1.

25    BHK cells expressing the human M1 receptor under the control of the inducible  
metallothionine promoter and maintained with the dihydrofolate reductase marker were

transfected with the PKC $\alpha$ -F64L-S65T-GFP probe using the calcium phosphate precipitate method in HEPES buffered saline (HBS [pH 7.10]). Stable transfectants were selected using 1000  $\mu$ g Zeocin®/ml in the growth medium (DMEM with 1000 mg glucose/l, 10 % foetal bovine serum (FBS), 100  $\mu$ g penicillin-streptomycin mixture ml<sup>-1</sup>, 2 mM l-glutamine). The hM1 receptor and PKC $\alpha$ -F64L-S65T-GFP fusion protein were maintained with 500 nM methotrexate and 500  $\mu$ g Zeocin®/ml respectively. 24 hours prior to any experiment, the cells were transferred to HAM F-12 medium with glutamax, 100  $\mu$ g penicillin-streptomycin mixture ml<sup>-1</sup> and 0.3 % FBS. This medium relieves selection pressure, gives a low induction of signal transduction pathways and has a low autofluorescence at the relevant wavelength enabling fluorescence microscopy of cells straight from the incubator.

#### Method 1: Monitoring the PKC $\alpha$ activity in real time:

Digital images of live cells were gathered using a Zeiss Axiovert 135M fluorescence microscope fitted with a 40X, NA: 1.3 oil immersion objective and coupled to a Photometrics CH250 charged coupled device (CCD) camera. The cells were illuminated with a 100 W arc lamp. In the light path was a 470 $\pm$ 20 nm excitation filter, a 510 nm dichroic mirror and a 515 $\pm$ 15 nm emission filter for minimal image background. The cells were kept and monitored to be at 37°C with a custom built stage heater.

Images were analyzed using the IPLab software package for Macintosh.

Upon stimulation of the M1-BHK cells, stably expressing the PKC $\alpha$ -F64L-S65T-GFP fusion, with carbachol we observed a dose-dependent transient translocation from the cytoplasm to the plasma membrane (Fig. 7a,b,c). Simultaneous measurement of the cytosolic free calcium concentration shows that the carbachol-induced calcium mobilisation precedes the translocation (Fig. 8).

#### Stepwise procedure for quantitation of translocation of PKC $\alpha$ :

1. The image was corrected for dark current by performing a pixel-by-pixel subtraction of a dark image (an image taken under the same conditions as the actual image, except the camera shutter is not allowed to open).
2. The image was corrected for non-uniformity of the illumination by performing a pixel-by-pixel ratio with a flat field correction image (an image taken under the same conditions as the actual image of a uniformly fluorescent specimen).
3. A copy of the image was made in which the edges are identified. The edges in the image are found by a standard edge-detection procedure – convolving the image with a kernel which removes any large-scale unchanging components (i.e., background) and accentuates any small-scale changes (i.e., sharp edges). This image was then converted to a binary image by thresholding. Objects in the binary image which are too small to represent the edges of cells were discarded. A dilation of the binary image was performed to close any gaps in the image edges. Any edge objects in the image which were in contact with the borders of the image are discarded. This binary image represents the edge mask.
4. Another copy of image was made via the procedure in step 3. This copy was further processed to detect objects which enclose “holes” and setting all pixels inside the holes to the binary value of the edge, i.e., one. This image represents the whole cell mask.
5. The original image was masked with the edge mask from step 3 and the sum total of all pixel values is determined.
6. The original image was masked with the whole cell mask from step 4 and the sum total of all pixel values was determined.
7. The value from step 5 was divided by the value from step 6 to give the final result, the fraction of fluorescence intensity in the cells which was localized in the edges.

### EXAMPLE 3

**Probes for detection of mitogen activated protein kinase Erk1 redistribution.**

Useful for monitoring signalling pathways involving MAPK, e.g. to identify compounds which modulate the activity of the pathway in living cells.

Erk1, a serine/threonine protein kinase, is a component of a signalling pathway that is  
5 activated by e.g. many growth factors.

Probes for detection of ERK-1 activity in real time within living cells:

The extracellular signal regulated kinase (ERK-1, a mitogen activated protein kinase, MAPK) is fused N- or C-terminally to a derivative of GFP. The resulting fusions expressed in different mammalian cells are used for monitoring *in vivo* the nuclear  
10 translocation, and thereby the activation, of ERK1 in response to stimuli that activate the MAPK pathway.

a) Construction of murine ERK1 - F64L-S65T-GFP fusion:

Convenient restriction endonuclease sites are introduced into the cDNAs encoding murine ERK1 (GenBank Accession number: Z14249) and F64L-S65T-GFP (sequence  
15 disclosed in WO 97/11094) by polymerase chain reaction (PCR). The PCR reactions are performed according to standard protocols with the following primers:

5'ERK1:

TTggACACAAgCTTTggACACCCTCAggATATggCggCggCggCggCggCTCCggggggg  
Cggggg (SEQ ID NO:7),

20 3'ERK1:

gTCATCTTCTCgAgTCTTTCAggCgCgCCCggggCCCTCTggCgCCCCTggCTgg  
(SEQ ID NO:8),

5'F64L-S65T-GFP:

TTggACACAAgCTTTggACACggCgCgCCATgAgTAAAggAgAAgAACTTTTC  
25 (SEQ ID NO:1)



3'F64L-S65T-GFP:

gTCATCTTCTCgAgTCTTACTCCTgAggTTTgTATAgTTCATCCATgCCATgT (SEQ ID NO:2)

To generate the mERK1-F64L-S65T-GFP (SEQ ID NO:56 & 57) fusion the ERK1  
5 amplification product is digested with HindIII+AscI and the F64L-S65T-GFP product  
with AscI+XhoI. To generate the F64L-S65T-GFP-mERK1 fusion the ERK1  
amplification product is then digested with HindIII+Bsu36I and the F64L-S65T-GFP  
product with Bsu36I+XhoI. The two pairs of digested PCR products are subsequently  
ligated with a HindIII+XhoI digested plasmid (pZeoSV® mammalian expression  
10 vector, Invitrogen, San Diego, CA, USA). The resulting fusion constructs are under  
control of the SV40 promoter.

b) The human Erk1 gene (GenBank Accession number: X60188) was amplified using  
PCR according to standard protocols with primers Erk1-top (SEQ ID NO:9) and Erk1-  
bottom/+stop (SEQ ID NO:10). The PCR product was digested with restriction  
15 enzymes EcoR1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto;  
GenBank Accession number U55763) digested with EcoR1 and BamH1. This produces  
an EGFP-Erk1 fusion (SEQ ID NO:38 & 39) under the control of a CMV promoter.

The plasmid containing the EGFP-Erk1 fusion was transfected into HEK293 cells  
employing the FUGENE transfection reagent (Boehringer Mannheim). Prior to  
20 experiments the cells were grown to 80%-90% confluency in 8 well chambers in DMEM  
with 10% FCS. The cells were washed in plain HAM F-12 medium (without FCS), and  
then incubated for 30-60 minutes in plain HAM F-12 (without FCS) with 100 micromolar  
PD98059, an inhibitor of MEK1, a kinase which activates Erk1; this step effectively  
empties the nucleus of EGFP-Erk1. Just before starting the experiment, the HAM F-12 was  
25 replaced with Hepes buffer following a wash with Hepes buffer. This removes the  
PD98059 inhibitor; if blocking of MEK1 is still wanted (e.g. in control experiments), the  
inhibitor is included in the Hepes buffer.

The experimental setup of the microscope was as described in example 1.

60 images were collected with 10 seconds between each, and with the test compound added after image number 10.

Addition of EGF (1-100 nM) caused within minutes a redistribution of EGFP-Erk1 from the cytoplasm into the nucleus (Fig. 9a,b).

- 5 The response was quantitated as described below and a dose-dependent relationship between EGF concentration and nuclear translocation of EGFP-Erk1 was found (Fig. 9c,d). Redistribution of GFP fluorescence is expressed in this example as the change in the ratio value between areas in nuclear versus cytoplasmic compartments of the cell. Each time profile is the average of nuclear to cytoplasmic ratios from six cells in each treatment.

10

#### EXAMPLE 4

##### **Probes for detection of Erk2 redistribution.**

Useful for monitoring signalling pathways involving MAPK, e.g. to identify compounds which modulate the activity of the pathway in living cells.

- 15 Erk2, a serine/threonine protein kinase, is closely related to Erk1 but not identical; it is a component of a signalling pathway that is activated by e.g. many growth factors.
- a) The rat Erk2 gene (GenBank Accession number: M64300) was amplified using PCR according to standard protocols with primers Erk2-top (SEQ ID NO:11) and Erk2-bottom/+stop (SEQ ID NO:13) The PCR product was digested with restriction enzymes
- 20 Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produces an EGFP-Erk2 fusion (SEQ ID NO:40 &41) under the control of a CMV promoter.
- b) The rat Erk2 gene (GenBank Accession number: M64300) was amplified using PCR according to standard protocols with primers (SEQ ID NO:11) Erk2-top and Erk2-
- 25 bottom/-stop (SEQ ID NO:12). The PCR product was digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank

Accession number U55762) digested with XhoI and BamHI. This produces an Erk2-EGFP fusion (SEQ ID NO:58 &59) under the control of a CMV promoter.

The resulting plasmids were transfected into CHO cells and BHK cells. The cells were grown under standard conditions. Prior to experiments, the cells were starved in medium without serum for 48-72 hours. This led to a predominantly cytoplasmic localisation of both probes, especially in BHK cells. 10% fetal calf serum was added to the cells and the fluorescence of the cells was recorded as explained in example 3. Addition of serum caused the probes to redistribute into the nucleus within minutes of addition of serum.

## 10 EXAMPLE 5

### **Probes for detection of Smad2 redistribution.**

Useful for monitoring signalling pathways activated by some members of the transforming growth factor-beta family, e.g. to identify compounds which modulate the activity of the pathway in living cells.

15 Smad 2, a signal transducer, is a component of a signalling pathway that is induced by some members of the TGFbeta family of cytokines.

a) The human Smad2 gene (GenBank Accession number: AF027964) was amplified using PCR according to standard protocols with primers Smad2-top (SEQ ID NO:24) and Smad2-bottom/+stop (SEQ ID NO:26) . The PCR product was digested with restriction enzymes EcoR1 and Acc65I, and ligated into pEGFP-C1 (Clontech; Palo Alto; GenBank Accession number U55763) digested with EcoR1 and Acc65I. This produces an EGFP-Smad2 fusion (SEQ ID NO:50&51) under the control of a CMV promoter.

b) The human Smad2 gene (GenBank Accession number: AF027964) was amplified using PCR according to standard protocols with primers Smad2-top (SEQ ID NO:24) and Smad2-bottom/-stop (SEQ ID NO:25) . The PCR product was digested with restriction enzymes EcoR1 and Acc65I, and ligated into pEGFP-N1 (Clontech, Palo Alto;

GenBank Accession number U55762) digested with EcoR1 and Acc65I. This produces a Smad2-EGFP fusion (SEQ ID NO:74 &75) under the control of a CMV promoter.

5 The plasmid containing the EGFP-Smad2 fusion was transfected into HEK293 cells, where it showed a cytoplasmic distribution. Prior to experiments the cells were grown in 8 well Nunc chambers in DMEM with 10% FCS to 80% confluence and starved overnight in HAM F-12 medium without FCS.

For experiments, the HAM F-12 medium was replaced with Hepes buffer pH 7.2.

The experimental setup of the microscope was as described in example 1.

90 images were collected with 10 seconds between each, and with the test compound  
10 added after image number 5.

After serum starvation of cells, each nucleus contains less GFP fluorescence than the surrounding cytoplasm (Fig. 10a). Addition of TGFbeta caused within minutes a redistribution of EGFP-Smad2 from the cytoplasm into the nucleus (Fig. 10b).

The redistribution of fluorescence within the treated cells was quantified simply as the  
15 fractional increase in nuclear fluorescence normalised to the starting value of GFP fluorescence in the nucleus of each unstimulated cell.

## EXAMPLE 6

### **Probe for detection of VASP redistribution.**

20 Useful for monitoring signalling pathways involving rearrangement of cytoskeletal elements, e.g. to identify compounds which modulate the activity of the pathway in living cells.

VASP, a phosphoprotein, is a component of cytoskeletal structures, which redistributes in response to signals that affect focal adhesions.

The human VASP gene (GenBank Accession number: Z46389) was amplified using PCR according to standard protocols with primers VASP-top (SEQ ID NO:94) and VASP-bottom/+stop (SEQ ID NO:95). The PCR product was digested with restriction enzymes Hind3 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Hind3 and BamH1. This produces an EGFP-VASP fusion (SEQ ID NO:124 &125) under the control of a CMV promoter.

The resulting plasmid was transfected into CHO cells expressing the human insulin receptor using the calcium-phosphate transfection method. Prior to experiments, cells were grown in 8 well Nunc chambers and starved overnight in medium without FCS.

10 Experiments are performed in a microscope setup as described in example 1.

10% FCS was added to the cells and images were collected. The EGFP-VASP fusion was redistributed from a somewhat even distribution near the periphery into more localised structures, identified as focal adhesion points (Fig. 11).

15 A large number of further GFP fusions have been made or are in the process of being made, as apparent from the following Examples 7-22 which also suggest suitable host cells and substances for activation of the cellular signalling pathways to be monitored and analyzed.

#### EXAMPLE 7

##### 20 **Probe for detection of actin redistribution.**

Useful for monitoring signalling pathways involving rearrangement or formation of actin filaments, e.g. to identify compounds which modulate the activity of pathways leading to cytoskeletal rearrangements in living cells.

25 Actin is a component of cytoskeletal structures, which redistributes in response to very many cellular signals.

The actin binding domain of the human alpha-actinin gene (GenBank Accession number:

X15804) was amplified using PCR according to standard protocols with primers ABD-top (SEQ ID NO:90) and ABD-bottom/-stop (SEQ ID NO:91). The PCR product was digested with restriction enzymes Hind3 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Hind3 and BamH1. This  
5 produced an actin-binding-domain-EGFP fusion (SEQ ID NO:128 &129) under the control of a CMV promoter.

The resulting plasmid was transfected into CHO cells expressing the human insulin receptor. Cells were stimulated with insulin that caused the actin binding domain-EGFP probe to become redistributed into morphologically distinct membrane-associated  
10 structures.

## EXAMPLE 8

### Probes for detection of p38 redistribution.

Useful for monitoring signalling pathways responding to various cellular stress situations,  
15 e.g. to identify compounds which modulate the activity of the pathway in living cells, or as a counterscreen.

p38, a serine/threonine protein kinase, is a component of a stress-induced signalling pathway which is activated by many types of cellular stress, e.g. TNFalpha, anisomycin, UV and mitomycin C.

- 20 a) The human p38 gene (GenBank Accession number: L35253) was amplified using PCR according to standard protocols with primers p38-top (SEQ ID NO:14) and p38-bottom/+stop (SEQ ID NO: 16). The PCR product was digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produced an EGFP-  
25 p38 fusion (SEQ ID NO:46 & 47) under the control of a CMV promoter.
- b) The human p38 gene (GenBank Accession number: L35253) was amplified using PCR according to standard protocols with primers p38-top (SEQ ID NO:13) and p38-

bottom/-stop (SEQ ID NO:15) . The PCR product was digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Xho1 and BamH1. This produced a p38-EGFP fusion (SEQ ID NO:64 & 65) under the control of a CMV promoter.

- 5 The resulting plasmids are transfected into a suitable cell line, e.g. HEK293, in which the EGFP-p38 probe and/or the p38-EGFP probe should change its cellular distribution from predominantly cytoplasmic to nuclear within minutes in response to activation of the signalling pathway with e.g. anisomycin.

## 10 EXAMPLE 9

### **Probes for detection of Jnk1 redistribution.**

Useful for monitoring signalling pathways responding to various cellular stress situations, e.g. to identify compounds which modulate the activity of the pathway in living cells, or as a counterscreen.

- 15 Jnk1, a serine/threonine protein kinase, is a component of a stress-induced signalling pathway different from the p38 described above, though it also is activated by many types of cellular stress, e.g. TNFalpha, anisomycin and UV.
- a) The human Jnk1 gene (GenBank Accession number: L26318) was amplified using PCR according to standard protocols with primers Jnk-top (SEQ ID NO:17) and Jnk-
- 20 bottom/+stop (SEQ ID NO:19) . The PCR product was digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produced an EGFP-Jnk1 fusion (SEQ ID NO:44 &45) under the control of a CMV promoter.
- b) The human Jnk1 gene (GenBank Accession number: L26318) was amplified using PCR
- 25 according to standard protocols with primers Jnk-top (SEQ ID NO:17) and Jnk-bottom/-stop (SEQ ID NO:18) . The PCR product was digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank

Accession number U55762) digested with Xho1 and BamH1. This produced a Jnk1-EGFP fusion (SEQ ID NO:62 &63) under the control of a CMV promoter.

- The resulting plasmids are transfected into a suitable cell line, e.g. HEK293, in which the EGFP-Jnk1 probe and/or the Jnk1-EGFP probe should change its cellular distribution from predominantly cytoplasmic to nuclear in response to activation of the signalling pathway with e.g. anisomycin.

#### EXAMPLE 10

##### **Probes for detection of PKG redistribution.**

- Useful for monitoring signalling pathways involving changes in cyclic GMP levels, e.g. to identify compounds which modulate the activity of the pathway in living cells.

PGK, a cGMP-dependent serine/threonine protein kinase, mediates the guanylyl-cyclase/cGMP signal.

- a) The human PKG gene (GenBank Accession number: Y07512) is amplified using PCR according to standard protocols with primers PKG-top (SEQ ID NO:81) and PKG-bottom/+stop (SEQ ID NO:83) . The PCR product is digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produces an EGFP-PKG fusion (SEQ ID NO:134 &135) under the control of a CMV promoter.
- b) The human PKG gene (GenBank Accession number: Y07512) is amplified using PCR according to standard protocols with primers PKG-top (SEQ ID NO:81) and PKG-bottom/-stop (SEQ ID NO: 82) . The PCR product is digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Xho1 and BamH1. This produces a PKG-EGFP fusion (SEQ ID NO:136 &137) under the control of a CMV promoter.

The resulting plasmids are transfected into a suitable cell line, e.g. A10, in which the EGFP-PKG probe and/or the PKG-EGFP probe should change its cellular distribution



from cytoplasmic to one associated with cytoskeletal elements within minutes in response to treatment with agents which raise nitric oxide (NO) levels.

#### EXAMPLE 11

##### 5 **Probes for detection of IkappaB kinase redistribution.**

Useful for monitoring signalling pathways leading to NFkappaB activation, e.g. to identify compounds which modulate the activity of the pathway in living cells.

IkappaB kinase, a serine/threonine kinase, is a component of a signalling pathway which is activated by a variety of inducers including cytokines, lymphokines, growth factors and  
10 stress.

a) The alpha subunit of the human IkappaB kinase gene (GenBank Accession number: AF009225) is amplified using PCR according to standard protocols with primers IKK-top (SEQ ID NO:96) and IKK-bottom/+stop (SEQ ID NO:98). The PCR product is digested with restriction enzymes EcoR1 and Acc65I, and ligated into pEGFP-C1  
15 (Clontech, Palo Alto; GenBank Accession number U55763) digested with EcoR1 and Acc65I. This produces an EGFP-IkappaB-kinase fusion (SEQ ID NO:120 &121) under the control of a CMV promoter.

b) The alpha subunit of the human IkappaB kinase gene (GenBank Accession number: AF009225) is amplified using PCR according to standard protocols with primers IKK-top (SEQ ID NO:96) and IKK-bottom/-stop (SEQ ID NO:97). The PCR product is  
20 digested with restriction enzymes EcoR1 and Acc65I, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with EcoR1 and Acc65I. This produces an IkappaB-kinase-EGFP fusion (SEQ ID NO:122 &123) under the control of a CMV promoter.

25 The resulting plasmids are transfected into a suitable cell line, e.g. Jurkat, in which the EGFP-IkappaB-kinase probe and/or the IkappaB-kinase-EGFP probe should achieve a more cytoplasmic distribution within seconds following stimulation with e.g. TNFalpha.

## EXAMPLE 12

### **Probes for detection of CDK2 redistribution.**

Useful for monitoring signalling pathways of the cell cycle, e.g. to identify compounds  
5 that modulate the activity of the pathway in living cells.

CDK2, a cyclin-dependent serine/threonine kinase, is a component of the signalling system that regulates the cell cycle.

- a) The human CDK2 gene (GenBank Accession number: X61622) is amplified using PCR according to standard protocols with primers CDK2-top (SEQ ID NO:102) and CDK2-  
10 bottom/+stop (SEQ ID NO: 104). The PCR product is digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produces an EGFP-CDK2 fusion (SEQ ID NO:114 &115) under the control of a CMV promoter.
- b) The human CDK2 gene (GenBank Accession number: X61622) is amplified using PCR  
15 according to standard protocols with primers CDK2-top (SEQ ID NO:102) and CDK2-bottom/-stop (SEQ ID NO:103). The PCR product is digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Xho1 and BamH1. This produces a CDK2-EGFP fusion (SEQ ID NO:112 &113) under the control of a CMV promoter.
- 20 The resulting plasmids are transfected into a suitable cell line, e.g. HEK293 in which the EGFP-CDK2 probe and/or the CDK2-EGFP probe should change its cellular distribution from cytoplasmic in contact-inhibited cells, to nuclear location in response to activation with a number of growth factors, e.g. IGF.

## 25 EXAMPLE 13

### **Probes for detection of Grk5 redistribution.**

Useful for monitoring signalling pathways involving desensitisation of G-protein coupled receptors, e.g. to identify compounds which modulate the activity of the pathway in living cells.

Grk5, a G-protein coupled receptor kinase, is a component of signalling pathways involving membrane bound G-protein coupled receptors.

a) The human Grk5 gene (GenBank Accession number: L15388) is amplified using PCR according to standard protocols with primers Grk5-top (SEQ ID NO:27) and Grk5-bottom/+stop (SEQ ID NO:29). The PCR product is digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with EcoR1 and BamH1. This produces an EGFP-Grk5 fusion (SEQ ID NO:42 &43) under the control of a CMV promoter.

b) The human Grk5 gene (GenBank Accession number: L15388) is amplified using PCR according to standard protocols with primers Grk5-top (SEQ ID NO:27) and Grk5-bottom/-stop (SEQ ID NO:28). The PCR product is digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with EcoR1 and BamH1. This produces a Grk5-EGFP fusion (SEQ ID NO:60 &61) under the control of a CMV promoter.

The resulting plasmids are transfected into a suitable cell line, e.g. HEK293 expressing a rat dopamine D1A receptor, in which the EGFP-Grk5 probe and/or the Grk5-EGFP probe should change its cellular distribution from predominantly cytoplasmic to peripheral in response to activation of the signalling pathway with e.g. dopamine.

#### EXAMPLE 14

##### **Probes for detection of Zap70 redistribution.**

Useful for monitoring signalling pathways involving the T cell receptor, e.g. to identify compounds which modulate the activity of the pathway in living cells.

Zap70, a tyrosine kinase, is a component of a signalling pathway which is active in e.g. T-cell differentiation.

- 5 a) The human Zap70 gene (GenBank Accession number: L05148) is amplified using PCR according to standard protocols with primers Zap70-top (SEQ ID NO:105) and Zap70-bottom/+stop (SEQ ID NO:107). The PCR product is digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-C1 (GenBank Accession number U55763) digested with EcoR1 and BamH1. This produces an EGFP-Zap70 fusion (SEQ ID NO:108 &109) under the control of a CMV promoter.
- 10 b) The human Zap70 gene (GenBank Accession number: L05148) is amplified using PCR according to standard protocols with primers Zap70-top (SEQ ID NO:105) and Zap70-bottom/-stop (SEQ ID NO:106). The PCR product is digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with EcoR1 and BamH1. This produces a Zap70-EGFP fusion (SEQ ID NO:110 &111) under the control of a CMV promoter.
- 15 The resulting plasmids are transfected into a suitable cell line, e.g. Jurkat, in which the EGFP-Zap70 probe and/or the Zap70-EGFP probe should change its cellular distribution from cytoplasmic to membrane-associated within seconds in response to activation of the T cell receptor signalling pathway with e.g. antibodies to CD3epsilon.

## 20 EXAMPLE 15

### **Probes for detection of p85 redistribution.**

Useful for monitoring signalling pathways involving PI-3 kinase, e.g. to identify compounds which modulate the activity of the pathway in living cells.

- 25 p85alpha is the regulatory subunit of PI3-kinase which is a component of many pathways involving membrane-bound tyrosine kinase receptors and G-protein-coupled receptors.

- a) The human p85alpha gene (GenBank Accession number: M61906) was amplified using PCR according to standard protocols with primers p85-top-C (SEQ ID NO:22) and p85-

bottom/+stop (SEQ ID NO:23) . The PCR product was digested with restriction enzymes Bgl2 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Bgl2 and BamH1. This produced an EGFP-p85alpha fusion (SEQ ID NO:48 &49) under the control of a CMV promoter.

- 5 b) The human p85alpha gene (GenBank Accession number: M61906) was amplified using PCR according to standard protocols with primers p85-top-N (SEQ ID NO:20) and p85-bottom/-stop (SEQ ID NO:21) . The PCR product was digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with EcoR1 and BamH1. This produced  
10 a p85alpha-EGFP fusion (SEQ ID NO:66 &67) under the control of a CMV promoter.

The resulting plasmids are transfected into a suitable cell line, e.g. CHO expressing the human insulin receptor, in which the EGFP-p85 probe and/or the p85-EGFP probe may change its cellular distribution from cytoplasmic to membrane-associated within minutes in response to activation of the receptor with insulin.

15

## EXAMPLE 16

### **Probes for detection of protein-tyrosine phosphatase redistribution.**

Useful for monitoring signalling pathways involving tyrosine kinases, e.g. to identify compounds which modulate the activity of the pathway in living cells.

- 20 Protein-tyrosine phosphatase1C, a tyrosine-specific phosphatase, is an inhibitory component in signalling pathways involving e.g. some growth factors.

- a) The human protein-tyrosine phosphatase 1C gene (GenBank Accession number: X62055) is amplified using PCR according to standard protocols with primers PTP-top (SEQ ID NO:99) and PTP-bottom/+stop (SEQ ID NO:101). The PCR product is  
25 digested with restriction enzymes Xho1 and EcoR1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and EcoR1. This produces an EGFP-PTP fusion (SEQ ID NO:116 & 117) under the control

of a CMV promoter.

- b) The human protein-tyrosine phosphatase 1C gene (GenBank Accession number: X62055) is amplified using PCR according to standard protocols with primers PTP-top (SEQ ID NO:99) and PTP-bottom/-stop (SEQ ID NO:100). The PCR product is  
5 digested with restriction enzymes Xho1 and EcoR1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Xho1 and EcoR1. This produces a PTP-EGFP fusion (SEQ ID NO:118 & 119) under the control of a CMV promoter.

The resulting plasmids are transfected into a suitable cell line, e.g. MCF-7 in which the  
10 EGFP-PTP probe and/or the PTP-EGFP probe should change its cellular distribution from cytoplasm to the plasma membrane within minutes in response to activation of the growth inhibitory signalling pathway with e.g. somatostatin.

#### EXAMPLE 17

##### 15 **Probes for detection of Smad4 redistribution.**

Useful for monitoring signalling pathways involving most members of the transforming growth factor-beta family, e.g. to identify compounds which modulate the activity of the pathway in living cells.

Smad4, a signal transducer, is a common component of signalling pathways induced by  
20 various members of the TGFbeta family of cytokines.

- a) The human Smad4 gene (GenBank Accession number: U44378) was amplified using PCR according to standard protocols with primers Smad4-top and Smad4-bottom/+stop (SEQ ID NO:35) . The PCR product was digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number  
25 U55763) digested with EcoR1 and BamH1. This produce an EGFP-Smad4 fusion (SEQ ID NO:52 & 53) under the control of a CMV promoter.

- b) The human Smad4 gene (GenBank Accession number: U44378) was amplified using

PCR according to standard protocols with primers Smad4-top (SEQ ID NO:33) and Smad4-bottom/-stop (SEQ ID NO:34). The PCR product was digested with restriction enzymes EcoR1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with EcoR1 and BamH1. This produced  
5 a Smad4-EGFP fusion (SEQ ID NO:76 & 77) under the control of a CMV promoter.

The resulting plasmids are transfected into a cell line, e.g. HEK293 in which the EGFP-Smad4 probe and/or the Smad4-EGFP probe should change its cellular distribution within minutes from cytoplasmic to nuclear in response to activation of the signalling pathway with e.g. TGFbeta.

10

#### EXAMPLE 18

##### **Probes for detection of Stat5 redistribution.**

Useful for monitoring signalling pathways involving the activation of tyrosine kinases of the Jak family, e.g. to identify compounds that modulate the activity of the pathway in  
15 living cells.

Stat5, signal transducer and activator of transcription, is a component of signalling pathways that are induced by e.g. many cytokines and growth factors.

- a) The human Stat5 gene (GenBank Accession number: L41142) was amplified using  
20 PCR according to standard protocols with primers Stat5-top (SEQ ID NO:30) and Stat5-bottom/+stop (SEQ ID NO:32). The PCR product was digested with restriction enzymes Bgl2 and Acc65I, and ligated into pEGFP-C1 (Clontech; Palo Alto; GenBank Accession number U55763) digested with Bgl2 and Acc65I. This produced an EGFP-Stat5 fusion (SEQ ID NO:54 & 55) under the control of a CMV promoter.
- b) The human Stat5 gene (GenBank Accession number: L41142) was amplified using  
25 PCR according to standard protocols with primers Stat5-top (SEQ ID NO:30) and Stat5-bottom/-stop (SEQ ID NO:331). The PCR product was digested with restriction

enzymes Bgl2 and Acc65I, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Bgl2 and Acc65I. This produced a Stat5-EGFP fusion (SEQ ID NO:78 & 79) under the control of a CMV promoter.

5 The resulting plasmids are transfected into a suitable cell line, e.g. MIN6 in which the EGFP-Stat5 probe and/or the Stat5-EGFP probe should change its cellular distribution from cytoplasmic to nuclear within minutes in response to activation signalling pathway with e.g. prolactin.

#### EXAMPLE 19

##### 10 **Probes for detection of NFAT redistribution.**

Useful for monitoring signalling pathways involving activation of NFAT, e.g. to identify compounds which modulate the activity of the pathway in living cells.

NFAT, an activator of transcription, is a component of signalling pathways involved in e.g. immune responses.

15 a) The human NFAT1 gene (GenBank Accession number: U43342) is amplified using PCR according to standard protocols with primers NFAT-top (SEQ ID NO:84) and NFAT-bottom/+stop (SEQ ID NO:86). The PCR product is digested with restriction enzymes Xho1 and EcoR1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and EcoR1. This produces an EGFP-  
20 NFAT fusion (SEQ ID NO:130 & 131) under the control of a CMV promoter.

b) The human NFAT gene (GenBank Accession number: U43342) is amplified using PCR according to standard protocols with primers NFAT-top (SEQ ID NO:84) and NFAT-bottom/-stop (SEQ ID NO:85). The PCR product is digested with restriction enzymes Xho1 and EcoR1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank  
25 Accession number U55762) digested with Xho1 and EcoR1. This produces an NFAT-EGFP fusion (SEQ ID NO:132 & 133) under the control of a CMV promoter.

The resulting plasmids are transfected into a suitable cell line, e.g. Jurkat, in which the



EGFP-NFAT probe and/or the NFAT-EGFP probe should change its cellular distribution from cytoplasmic to nuclear within minutes in response to activation of the signalling pathway with e.g. antibodies to CD3epsilon.

## 5 EXAMPLE 20

### **Probes for detection of NFkappaB redistribution.**

Useful for monitoring signalling pathways leading to activation of NFkappaB, e.g. to identify compounds which modulate the activity of the pathway in living cells.

10 NFkappaB, an activator of transcription, is a component of signalling pathways that are responsive to a variety of inducers including cytokines, lymphokines, and some immunosuppressive agents.

a) The human NFkappaB p65 subunit gene (GenBank Accession number: M62399) is amplified using PCR according to standard protocols with primers NFkappaB-top (SEQ ID NO:87) and NFkappaB-bottom/+stop (SEQ ID NO:89). The PCR product is  
15 digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produces an EGFP-NFkappaB fusion (SEQ ID NO:142 & 143) under the control of a CMV promoter.

b) The human NFkappaB p65 subunit gene (GenBank Accession number: M62399) is  
20 amplified using PCR according to standard protocols with primers NFkappaB-top (SEQ ID NO:87) and NFkappaB-bottom/-stop (SEQ ID NO:88). The PCR product is digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Xho1 and BamH1. This produces an NFkappaB-EGFP fusion (SEQ ID NO:140 & 141) under the control of a  
25 CMV promoter.

The resulting plasmids are transfected into a suitable cell line, e.g. Jurkat, in which the EGFP-NFkappaB probe and/or the NFkappaB-EGFP probe should change its cellular

distribution from cytoplasmic to nuclear in response to activation of the signalling pathway with e.g. TNFalpha.

#### EXAMPLE 21

##### 5 **Probe for detection of RhoA redistribution.**

Useful for monitoring signalling pathways involving RhoA, e.g. to identify compounds which modulate the activity of the pathway in living cells.

RhoA, a small GTPase, is a component of many signalling pathways, e.g. LPA induced cytoskeletal rearrangements.

- 10 The human RhoA gene (GenBank Accession number: L25080) was amplified using PCR according to standard protocols with primers RhoA-top (SEQ ID NO:92) and RhoA-bottom/+stop (SEQ ID NO:93). The PCR product was digested with restriction enzymes Hind3 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Hind3 and BamH1. This produced an EGFP-RhoA fusion  
15 (SEQ ID NO:126 & 127) under the control of a CMV promoter.

The resulting plasmid is transfected into a suitable cell line, e.g. Swiss3T3, in which the EGFP-RhoA probe should change its cellular distribution from a reasonably homogenous to a peripheral distribution within minutes of activation of the signalling pathway with e.g. LPA.

20

#### EXAMPLE 22

##### **Probes for detection of PKB redistribution.**

Useful for monitoring signalling pathways involving PKB e.g. to identify compounds which modulate the activity of the pathway in living cells.

- 25 PKB, a serine/threonine kinase, is a component in various signalling pathways, many of

which are activated by growth factors.

- a) The human PKB gene (GenBank Accession number: M63167) is amplified using PCR according to standard protocols with primers PKB-top (SEQ ID NO:36) and PKB-bottom/+stop (SEQ ID NO:80). The PCR product is digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-C1 (Clontech, Palo Alto; GenBank Accession number U55763) digested with Xho1 and BamH1. This produces an EGFP-PKB fusion (SEQ ID NO:138 & 139) under the control of a CMV promoter.
- b) The human PKB gene (GenBank Accession number: M63167) was amplified using PCR according to standard protocols with primers PKB-top (SEQ ID NO:36) and PKB-bottom/-stop (SEQ ID NO:37). The PCR product was digested with restriction enzymes Xho1 and BamH1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Xho1 and BamH1. This produced a PKB-EGFP fusion (SEQ ID NO:70 & 71) under the control of a CMV promoter.
- The resulting plasmids are transfected into a suitable cell line, e.g. CHO expressing the human insulin receptor, in which the EGFP-PKB probe and/or the PKB-EGFP probe cycles between cytoplasmic and membrane locations during the activation-deactivation process following addition of insulin. The transition should be apparent within minutes.

## EXAMPLE 23

**Measurement of the real-time redistribution of protein kinase C  $\alpha$  isoform-GFP fusion (PKC $\alpha$ -GFP) in response to carbamylcholine stimulation of the muscarinic M1 receptor; 96 parallel redistribution measurements in microtiter plates.**

BHK cells were stably expressing a recombinant human muscarinic typ 1 receptor, under the selection with 500  $\mu$ g/ml Methotrexate, and also a PKC $\alpha$ -GFP construct (KaA 048), under the selection of 500 nM Zeocin. The cells were grown in 96-well plates (Packard ViewPlate, black with transparent bottom), washed and preincubated in a Hank's Buffered

Salt solution (HBSS) without phenol red, with 20 mM HEPES and 5.5 mM glucose.

The plate was measured in a FLIPR™ (Fluorescence Imaging Plate Reader) from Molecular Devices. The 488 nm emission line from an argon ion laser, run at between 0.4 and 0.8 W output, was used to excite fluorescence from the GFP. Emission wavelengths  
5 were collected through a 510 to 565 nm band pass filter.

The cells were challenged with three doses of carbamylcholine, an M1 receptor agonist known from previous studies to give a microscopically detectable redistribution of the PKC $\alpha$ -GFP construct [(Almholt *et al.* 1997)]. Measurements were made every 10 seconds for 5 minutes. After data handling including normalisation of baseline fluorescence for the  
10 different wells, background subtraction and averaging the 6 wells used for each concentration the data presented in figure 14 were obtained. It can clearly be seen (Fig 14) that carbamylcholine gave a time- and dose-dependent, and transient, decrease in fluorescence very similar to the time- and dose-dependent profile seen in microscopic fluorescence measurements [(see Almholt *et al.* 1997)]. This experiment was repeated  
15 twice on the same batch of cells with similar results.

#### EXAMPLE 24

**Measurement of the real-time redistribution of cyclic-AMP dependent protein kinase catalytic subunit-GFP fusion (C-GFP<sup>LT</sup>) in response to forskolin stimulation of the  
20 adenylate cyclase; 96 parallel redistribution measurements in microtiter plates.**

CHO cells were stably transfected with hybrid DNA for the PKA catalytic subunit-F64L+S65T GFP (C-GFP<sup>LT</sup>) fusion protein, and were typically under continuous selection with 1000  $\mu$ g/ml zeocin (Invitrogen). The cells were grown without selection for 2 days in 96-well plates (Packard ViewPlate, black with transparent bottom), washed and  
25 preincubated in a Hank's Buffered Salt solution (HBSS) without phenol red, with 20 mM HEPES and 5.5 mM glucose.

The plate was measured in a FLIPR™ (Fluorescence Imaging Plate Reader) from Molecular Devices. The 488 nm emission line from an argon ion laser, run at between 0.4

and 0.8 W output, was used to excite fluorescence from the GFP. Emission wavelengths were collected through a 510 to 565 nm band pass filter.

The cells were challenged with three doses of forskolin (Fig 15), an adenylate cyclase agonist known from previous studies to give a microscopically detectable redistribution of the C-GFP<sup>LT</sup> construct [(Almholt *et al.* 1998)]. Measurements were made every 10 seconds for over 6 minutes from the point of addition of forskolin. After data handling including normalisation of baseline fluorescence for the different wells, background subtraction and averaging the 6 wells used for each concentration the data presented below were obtained. It can clearly be seen in figure 15 that forskolin gave a time- and dose-dependent decrease in fluorescence very similar to the time- and dose-dependent profile seen in microscopic fluorescence measurements [(see Almholt *et al.* 1998)]. This experiment was repeated twice on the same batch of cells with similar results.

#### EXAMPLE 25

**Measurement of the redistribution response of cyclic-AMP dependent protein kinase catalytic subunit-GFP fusion (C-GFP<sup>LT</sup>) after forskolin stimulation of the adenylate cyclase; measurement of the change in total fluorescence upon permeabilisation of agonist-treated cells.**

CHO cells were stably transfected with hybrid DNA for the PKA catalytic subunit-F64L+S65T GFP (C-GFP<sup>LT</sup>) fusion protein, and were typically under continuous selection with 1000 µg/ml zeocin (Invitrogen). For the experiments reported here, cells were grown without selection to 90% confluence in 8-well tissue culture-treated Lab-Tek® chambered coverglass units (chambers, obtained from Nunc, Inc. Illinois, USA). Immediately prior to the experiment growth medium was washed from the cells and replaced with 200 µl HEPES buffer per well.

For the results reported here, chambers were measured using a cooled CCD camera (KAF1400 chip, Photometrics Ltd., USA) attached to an inverted microscope (Diaphot 300, Nikon, Japan) equipped with a x40 oil-immersion Fluor lens, NA 1.4. Cells were

illuminated with 450-490 nm light from a 50 W HBO lamp, and emitted light collected between 510-560 nm.

The cells were challenged with four doses of forskolin, an adenylate cyclase agonist known from previous studies to give a microscopically detectable redistribution of the C-GFP<sup>LT</sup> construct [(Almholt *et al.* 1998)]. Images were collected at 10-second intervals for a period of 10 minutes for each treatment. Six minutes after the addition of forskolin or buffer control, Triton-X100 was added to a final concentration of 0.1%. The detergent releases freely mobile C-GFP<sup>LT</sup> from the cells. The change in fluorescence resulting from this loss was measured after 1 minute of equilibration. After data handling including background subtraction and normalisation to pre-detergent values, the data presented in figure 16 were obtained. Permeabilisation caused decreases in fluorescence, the magnitude of which were dependent on the forskolin treatments. The dose-dependent profile for forskolin activation of the cAMP system as revealed by this method was very similar to that registered by other methods (see Almholt *et al.* 1998). This experiment was repeated twice on the same batch of cells with similar results.

## EXAMPLE 26

### Probe for detection of PKCbeta2 redistribution.

Useful for monitoring signalling pathways involving protein kinase C, e.g. for identifying compounds which modulate the activity of the pathway in living cells.

PKCbeta2, a serine/threonine protein kinase, is closely related to PKCalpha but not identical; it is a component of a signalling pathway that is activated by elevation of intracellular calcium concomitant with an increase in diacylglycerol species.

a) The human PKCbeta2 gene (GenBank Accession number: X07109) was amplified using PCR according to standard protocols with primers PKCbeta2-top (SEQ ID NO:162) and PKCbeta2-bottom (SEQ ID NO:163). The PCR product was digested with restriction enzymes XhoI and BamHI, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with XhoI and BamHI. This produces a PKCbeta2-

EGFP fusion (SEQ ID NO:146 & 147) under the control of a CMV promoter.

The resulting plasmids are transfected into BHK cells transfected with a human muscarinic acetylcholine receptor type M1. The cells are grown under standard conditions. The fluorescence of the cells is recorded as explained in example 3. Addition of 1 $\mu$ M -100 $\mu$ M carbachol causes a transient redistribution of fluorescence within the cells whereby it changes from a cytosolic location to the plasma membrane.

#### EXAMPLE 27

##### **Probes for detection of PDE4D redistribution.**

- Useful for monitoring signalling pathways involving Protein Kinase A, e.g. to identify compounds which modulate the activity of the pathway in living cells.

PDE4D3, PDE4D4 and PDE4D5 are closely related splicing variants of PDE4D, a cAMP dependent phosphodiesterase. They are components of signalling pathways which involves cAMP.

- The human PDE4D3, PDE4D4 and PDE4D5 genes (GenBank Accession numbers: L20970, L20969 and AF012073) are amplified using PCR according to standard protocols with the common bottom primer PDE4D-bottom (SEQ ID NO:159) and PDE4D3-top (SEQ ID NO:156), PDE4D4-top (SEQ ID NO:157) and PDE4D5-top respectively (SEQ ID NO:158) The PCR products are digested with restriction enzymes Hind3 and EcoR1, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with Hind3 and EcoR1. This produces a PDE4D3-EGFP fusion (SEQ ID NO:154 & 155), a PDE4D4-EGFP fusion (SEQ ID NO:150 & 151) and a PDE4D5-EGFP fusion (SEQ ID NO:148 & 149), all three under the control of a CMV promoter.

- The resulting plasmids are transfected into MVLEC cells. The cells are grown under standard conditions. The fluorescence of the cells is recorded as explained in example 3. Addition of test compounds may cause a redistribution of fluorescence within the cells from an organised cytosolic distribution to a more random one.

**EXAMPLE 28****Probes for detection of PDE5 redistribution.**

Useful for monitoring signalling pathways involving Protein Kinase G, e.g. to identify  
5 compounds which modulate the activity of the pathway in living cells.

PDE5 is a cGMP specific phosphodiesterase. It is a component of a signalling pathway which is activated by e.g. nitric oxide.

a) The human PDE5 gene (GenBank Accession numbers: AJ004865) is amplified using PCR according to standard protocols with primers PDE5-top (SEQ ID NO:160) and PDE5-  
10 bottom (SEQ ID NO:161). The PCR product is digested with restriction enzymes EcoR1 and Acc65I, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number U55762) digested with EcoR1 and Acc65I. This produces a PDE5-EGFP fusion (SEQ ID NO 144 & 145) under the control of a CMV promoter.

The resulting plasmids are transfected into e.g. A10 cells. The cells are grown under  
15 standard conditions. The fluorescence of the cells is recorded as explained in example 3. Addition of test compounds may cause a redistribution of fluorescence within the cells from an organized cytosolic distribution to a more random one.

**EXAMPLE 29****20 Probe for detection of Ikappa-kinase redistribution.**

The human IKKbeta (GenBank Acc. No. AF031416) is amplified using PCR according to standard protocols with primers IKKbeta-top (SEQ ID NO:164) and IKKbeta-bottom (SEQ ID NO:165). The PCR product is digested with restriction enzymes Hind3 and Acc65I, and ligated into pEGFP-N1 (Clontech, Palo Alto; GenBank Accession number  
25 U55762) digested with Hind3 and Acc65I. This produces a IKKbeta-EGFP fusion (SEQ ID NO 152 & 153) under the control of a CMV promoter.



**EXAMPLE 30****Construction of catalytically inactive Erk1 probes.**

5 A catalytically inactive probe has the advantage that it interferes less with the normal physiology of the cell while retaining its ability to report on activation of a cellular signalling pathway by redistribution.

The Erk1 probes described above in Example 3 were subjected to site specific mutagenesis which specifically replaced the lysine at amino acid residue number 71 in the native Erk1 sequence with arginine. This mutation is known to inactivate the catalytic activity of Erk1.

10 The redistribution patterns of the inactive Erk1 probes were identical to the original Erk1 probes, i.e. they reported on activation of the pathway by redistributing from the cytoplasm into the nucleus. The establishment of stable cell lines expressing the probe was facilitated.

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## CLAIMS

1. A method for extracting quantitative information relating to an influence on a cellular response, the method comprising recording variation, caused by the influence on mechanically intact or permeabilised living cells, in spatially distributed light emitted from a luminophore, the luminophore being present in the cells and being capable of being redistributed in a manner which is related with the degree of the influence, and/or of being modulated by a component which is capable of being redistributed in a manner which is related to the degree of the influence, resulting in a modulation of the luminescence characteristics of the luminophore, and processing the recorded variation in the luminescence characteristics to provide quantitative information correlating the recorded variation to the degree of the influence on the cellular response.
2. A method according to claim 1 for extracting quantitative information relating to an influence on an intracellular pathway involving redistribution of at least one component associated with the pathway, or part thereof, the method comprising recording the result of the influence on mechanically intact or permeabilised living cells, as manifested in spatially distributed light emitted from a luminophore which is present in the cells and which is capable of being redistributed, by modulation of the pathway, in a manner which is related to the redistribution of the at least one component of the intracellular pathway, processing the recorded result to provide quantitative information correlating the change in the measured property of the light to the degree of the influence on the intracellular pathway.
3. A method according to claim 1 or 2, wherein the quantitative information which is indicative of the degree of the cellular response to the influence or the result of the influence on the intracellular pathway is extracted from the recorded variation according to a predetermined calibration based on responses or results, recorded in the same manner, to known degrees of a relevant specific influence.
4. A method according to any of claims 1-3, wherein the influence comprises contact between the mechanically intact or permeabilised living cells and a chemical substance and/or incubation of the mechanically intact or permeabilised living cells with a chemical substance.

5. A method according to any of claims 1-4, wherein the influence is a substance whose effect on an intracellular pathway is to be determined.
6. A method according to any of claims 1-5, wherein the cells comprise a group of cells contained within a spatial limitation.
- 5 7. A method according to any of claims 1-5, wherein the cells comprise multiple groups of cells contained within multiple spatial limitations.
8. A method according to any of claims 1-7, wherein the cells comprise multiple groups of cells that are qualitatively the same but are subjected to different influences.
9. A method according to any of claims 1-7, wherein the cells comprise multiple groups  
10 of cells that are qualitatively different but are subjected to the same influence.
10. A method according to any of claims 1-9, wherein the recording is performed by means of a detector capable of measuring total luminescence in a non-spatially resolved fashion, the recording comprising a time series of measurements of the total luminescence of the cells of one or several of the spatial limitations.
- 15 11. A method according to claim 10, wherein the signal is measured from individual spatial limitations one at a time, the recording being made in the individual spatial limitation by means of an apparatus to sequentially position each one of the limitations in the field of view of the detector, and repeating the positioning and measuring process until all of the spatial limitations have been measured.
- 20 12. A method according to claim 11, wherein the detector is a photomultiplier tube (PMT).
13. A method according to any of claims 1-9, wherein more than one of the spatial limitations are measured simultaneously.
14. A method according to claim 13, wherein the multiple spatial limitations are measured  
25 simultaneously by means of a one- or two-dimensional array detector, whereby the multiple spatial limitations are imaged onto the array detector such that discrete subsets of the detecting units (pixels) in the array detector measure the signal from one and

only one of the multiple spatial limitations, the signal from any one spatial limitation being the combined signal from those pixels that receive the image from one of the spatial limitations.

15. A method according to claim 14, wherein the detector is a linear diode array.
- 5 16. A method according to claim 14, wherein the detector is a video camera.
17. A method according to claim 14, wherein the detector is a charge transfer device.
18. A method according to claim 17, wherein the charge transfer device is a charge-coupled device.
19. A method according to any of claims 1-18, wherein the luminophore must be  
10 illuminated in order to emit light.
20. A method according to any of claims 13-18, wherein all of the multiple spatial limitations are simultaneously illuminated during the measurement operation.
21. A method according to any of claims 10-18, wherein the individual spatial limitations are singly illuminated only during the time period in which they are being measured.
- 15 22. A method according to any of claims 10-18, wherein the illumination is provided by a laser which is scanned in a raster fashion over some or all of the spatial limitations being measured, the scanning taking place at a rate substantially faster than the measurement process such that the illumination appears to the measurement process to be continuous in time and spatially uniform over the region being measured.
- 20 23. A method according to any of claims 1-22, wherein the spatial limitations are spatial limitations arranged in one or more arrays on a common carrier.
24. A method according to claim 23, wherein the spatial limitations are wells in a plate of microtiter type.
- 25 25. A method according to any of claims 1-22 wherein the spatial limitations are domains defined on a substrate on which the cells are present.

26. A method according to claim 25 wherein the domains are domains established by the presence of the cells on the substrate in a pattern defining the domains.
27. A method according to claim 25 wherein the domains are domains established by the spatial pattern of the influence as it is applied to or contacted with the cells.
- 5 28. A method according to any of claims 1-27, wherein the recording is performed at a series of points in time, in which the application of the influence occurs at some time after the first time point in the series of recordings, the recording being performed, e.g., with a predetermined time spacing of from 0.1 seconds to 1 hour, preferably from 1 to 60 seconds, more preferably from 1 to 30 seconds, in particular from 1 to 10 seconds, 10 over a time span of from 1 second to 12 hours, such as from 10 seconds to 12 hours, e.g., from 10 seconds to one hour, such as from 60 seconds to 30 minutes or 20 minutes.
29. A method according to claim 28, wherein the recording is made at two points in time, one point being before, and the other point being after the application of the influence.
- 15 30. A method according to any of claims 1-29, wherein the cells are fixed at a point in time after the application of the influence at which the response has been predetermined to be significant, and the recording is made at an arbitrary later time.
31. A method according to any of claims 1-30, wherein the luminophore is a luminophore that is capable of being redistributed in a manner that is physiologically relevant to the 20 degree of the influence.
32. A method according to any of claims 1-30, wherein the luminophore is a luminophore which is capable of associating with a component which is capable of being redistributed in manner which is physiologically relevant to the degree of the influence.
33. A method according to any of claims 1-30, wherein the luminophore is a luminophore 25 which is capable of being redistributed in a manner which is experimentally determined to be correlated to the degree of the influence.
34. A method according to any of claims 1-30, wherein the luminophore is a luminophore

which is capable of being redistributed, by modulation of the intracellular pathway, in substantially the same manner as the at least one component of the intracellular pathway.

35. A method according to any of claims 1-30, wherein the luminophore is a luminophore which is capable of being quenched upon spatial association with a component which is redistributed by modulation of the pathway, the quenching being measured as a decrease in the intensity of the luminescence.
36. A method according to any of claims 1-30, wherein the variation in spatially distributed light emitted by the luminophore is detected by a change in the resonance energy transfer between the luminophore and another luminescent entity capable of delivering energy to the luminophore, each of which has been selected or engineered to become part of, bound to or associated with particular components of the intracellular pathway, and one of which undergoes redistribution in response to the influence, thereby changing the amount of resonance energy transfer, the change in the resonance energy transfer being measured as a change in the intensity of emission from the luminophore.
37. A method according to any of claims 1-35, wherein the intensity of the light being recorded is a function of the fluorescence lifetime, polarisation, wavelength shift, or other property which is modulated as a result of the underlying cellular response.
38. A method according to any of claims 1-37, wherein the light to be measured passes through a filter which selects the desired component of the light to be measured and rejects other components.
39. A method according to any of claims 2-38, wherein the intracellular pathway is an intracellular signalling pathway.
40. A method according to any of claims 1-39, wherein the luminophore is a fluorophore.
41. A method according to any of claims 1-40, wherein the luminophore is a polypeptide encoded by and expressed from a nucleotide sequence harboured in the cells.



42. A method according to any of claims 1-41 for detecting intracellular redistribution of a biologically active polypeptide affecting intracellular processes upon activation, the method comprising
- a) culturing one or more cells containing a nucleotide sequence coding for a hybrid polypeptide comprising a GFP which is N- or C-terminally tagged, optionally through a linker, to a biologically active polypeptide under conditions permitting expression of the nucleotide sequence,
  - b) modulating the activity of the biologically active polypeptide by incubating the cells with a substance having biological activity, and
  - c) measuring the fluorescence produced by the incubated cells and determining the result or variation with respect to the fluorescence, such result or variation being indicative of the redistribution of a biologically active polypeptide in said cells.
43. A method according to claim 42, wherein the luminophore is a hybrid polypeptide comprising a fusion of at least a portion of each of two polypeptides one of which comprises a luminescent polypeptide and the other one of which comprises a biologically active polypeptide, as defined herein.
44. A method according to claim 43, wherein the luminescent polypeptide is a GFP as defined herein.
45. A method according to claim 44, wherein the GFP is selected from the group consisting of green fluorescent proteins having the F64L mutation as defined herein.
46. A method according to claim 45, wherein the GFP is a GFP variant selected from the group consisting of F64L-GFP, F64L-Y66H-GFP, F64L-S65T-GFP, and EGFP.
47. A method according to claim 42, wherein the nucleotide sequence is a DNA sequence.
48. A method according to claims 42-47, wherein the modulation is activation.
49. A method according to claims 42-47, wherein the modulation is deactivation.
50. A method according to any of claims 1-49, wherein the cells are selected from the

group consisting of fungal cells, such as yeast cells; invertebrate cells including insect cells; and vertebrate cells, such as mammalian cells.

51. A method according to claim 50, wherein the mechanically intact or permeabilised living cells are mammalian cells which, during the time period over which the influence is observed, are incubated at a temperature of 30°C or above, preferably at a temperature of from 32°C to 39°C, more preferably at a temperature of from 35°C to 38°C, and most preferably at a temperature of about 37°C.
52. A method according to any of claims 1-51, wherein the mechanically intact or permeabilised living cells are part of a matrix of identical or non-identical cells.
53. A method according to any of claims 41-52, wherein the nucleotide sequence has been introduced into the cells in the form of a nucleic acid construct coding for a fusion polypeptide comprising a biologically active polypeptide that is a component of an intracellular signalling pathway, or a part thereof, and a GFP.
54. A method according to claim 53, wherein the nucleic acid construct is a nucleic acid construct coding for a fusion polypeptide comprising a biologically active polypeptide that is a component of an intracellular signalling pathway, or a part thereof, and an F64L mutant of GFP.
55. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 53 or 54, wherein the biologically active polypeptide is a protein kinase or a phosphatase.
56. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 53 – 55, wherein the GFP is N- or C-terminally tagged, optionally via a peptide linker, to the biologically active polypeptide or part thereof.
57. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 53, 54 or 56, wherein the biologically active polypeptide is a transcription factor or a part thereof which changes cellular localisation upon activation.

58. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 53, 54 or 56, wherein the biologically active polypeptide is a protein, or a part thereof, which is associated with the cytoskeletal network and which changes cellular localisation upon activation.
- 5 59. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to any of claims 53-56, wherein the biologically active polypeptide is a protein kinase or a part thereof which changes cellular localisation upon activation.
60. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic  
10 acid construct according to claim 59, wherein the protein kinase is a serine/threonine protein kinase or a part thereof capable of changing intracellular localisation upon activation.
61. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a tyrosine protein.  
15 kinase or a part thereof capable of changing intracellular localisation upon activation.
62. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a phospholipid-dependent serine/threonine protein kinase or a part thereof capable of changing intracellular localisation upon activation.
- 20 63. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a cAMP-dependent protein kinase or a part thereof capable of changing cellular localisation upon activation.
64. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic  
25 acid construct according to claim 63 which codes for a PKAc-F64L-S65T-GFP fusion.
65. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a cGMP-dependent protein kinase or a part thereof capable of changing cellular localisation upon

activation.

66. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a calmodulin-dependent serine/threonine protein kinase or a part thereof capable of changing cellular localisation upon activation.
67. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a mitogen-activated serine/threonine protein kinase or a part thereof capable of changing cellular localisation upon activation.
68. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 67, which codes for an ERK1-F64L-S65T-GFP fusion.
69. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 67, which codes for an EGFP-ERK1 fusion.
70. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 59, wherein the protein kinase is a cyclin-dependent serine/threonine protein kinase or a part thereof capable of changing cellular localisation upon activation.
71. A method according to claim 53 or 54, wherein the nucleic acid construct is a nucleic acid construct according to claim 55 or 56, wherein the biologically active polypeptide is a protein phosphatase or a part thereof capable of changing cellular localisation upon activation.
72. A method according to claim 53 -71, wherein the nucleic acid construct is a nucleic acid construct which is a DNA construct.
73. A method according to claim 53 -72, wherein the nucleic acid construct is a nucleic acid construct according to any of claims 53-72 wherein the gene encoding GFP is derived from *Aequorea victoria*.

74. A method according to claim 73, wherein the nucleic acid construct is a nucleic acid construct according to claim 73 in which the gene encoding GFP is the gene encoding EGFP as defined herein.
75. A method according to claim 73, wherein the nucleic acid construct is a nucleic acid construct according to claim 73 in which the gene encoding a GFP is a gene encoding a GFP variant selected from F64L-GFP, F64L-Y66H-GFP and F64L-S65T-GFP.
76. A method according to claims 72 and 74, wherein the nucleic acid construct is a DNA construct according to claims 72 and 74 or, where applicable, 75, which is a construct as identified by any of the DNA sequences shown in SEQ ID NO: 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, and 152 or is a variant thereof capable of encoding the same fusion polypeptide or a fusion polypeptide which is biologically equivalent thereto, as defined herein.
77. A method comprising a cell containing a nucleic acid construct according to any of claims 53-76 and capable of expressing the sequence encoded by the construct.
78. A method comprising a cell according to claim 77, which is a eukaryotic cell.
79. A method comprising a cell according to claim 77, which is selected from the group consisting of fungal cells, such as yeast cells; invertebrate cells, including insect cells, and vertebrate cells, such as mammalian cells.
80. A method according to any of claims 1-79, as used in a screening program as defined herein.
81. A method according claim 80, wherein the method is a screening program for the identification of a biologically active substance as defined herein that directly or indirectly affects an intracellular signalling pathway and is potentially useful as a medicament, wherein the result of the individual measurement of each substance being screened which indicates its potential biological activity is based on measurement of the redistribution of spatially resolved luminescence in living cells and which undergoes a change in distribution upon activation of an intracellular signalling

pathway.

82. A method according to claim 80, wherein the method is a screening program for the identification of a biologically toxic substance as defined herein that exerts its toxic effect by interfering with an intracellular signalling pathway, wherein the result of the individual measurement of each substance being screened which indicates its potential biologically toxic activity is based on measurement of the redistribution of said fluorescent probe in living cells and which undergoes a change in distribution upon activation of an intracellular signalling pathway.
83. A method according to any of claims 1-82 wherein a fluorescent probe is used in back-tracking of signal transduction pathways as defined herein.
84. A method according to any of claims 1-83, for treating a condition or disease related to the intracellular function of a protein kinase comprising administering to a patient suffering from said condition or disease an effective amount of a compound which has been discovered by any method.
85. A compound that modulates a component of an intracellular pathway as defined herein, as determined by any method according to any of claims 1-83.
86. A medical composition comprising a therapeutic amount of a compound identified according to any method according to any of claims 1-83.
87. A method of selectively treating a patient suffering from an ailment which responds to medical treatment comprising obtaining a primary cells from said patient, transfecting the cells with at least one DNA sequence encoding a fluorescent probe according to any of the preceding claims, culturing the cells under conditions permitting the expression of said probes and exposing it to an array of medicaments suspected of being capable of alleviating said ailment, then comparing changes in fluorescence patterns or redistribution patterns of the fluorescent probes in the intact living cells to detect the cellular response to the specific medicaments (obtaining a cellular action profile), then selecting a medicament(s) based on desired activity and acceptable level of side effects and administering an effective amount of said medicament(s) to said

patient.

88. A method according to any of claims 1-83 of identifying a drug target among the group of biologically active polypeptides that are components of intracellular signalling pathways.

## **ABSTRACT**

An improved method and tools for quantifying the effect of an influence on cellular response is described. In particular, an improved method is described for detecting intracellular translocation or redistribution of biologically active polypeptides. The invention also describes several ways of contacting the cells with a substance influencing a cellular response and extracting quantitative information relating to the response in a highly parallel fashion. The method may be used as a very efficient procedure for testing or discovering the influence of a substance on a physiological process using commercially available parallel, high volume assay techniques, for example in connection with screening for new drugs, testing of substances for toxicity, and identifying drug targets for known or novel drugs.



Modtaget PD  
15 OKT. 1998

SEQUENCE LISTING

(1) GENERAL INFORMATION

- (i) APPLICANT: NovoNordisk, BioImage
- (ii) TITLE OF THE INVENTION: An Improved Method of Detecting Cellular Translocation of Biologically Active Polypeptides Using Fluorescence Imaging
- (iii) NUMBER OF SEQUENCES: 165
- (iv) CORRESPONDENCE ADDRESS:
  - (A) ADDRESSEE: NovoNordisk, BioImage
  - (B) STREET: Mørkhøjbygade 28
  - (C) CITY: Søborg
  - (D) STATE: DK
  - (E) COUNTRY: DENMARK
  - (F) ZIP: 2860
- (v) COMPUTER READABLE FORM:
  - (A) MEDIUM TYPE: Diskette
  - (B) COMPUTER: IBM Compatible
  - (C) OPERATING SYSTEM: DOS
  - (D) SOFTWARE: FastSEQ for Windows Version 2.0
- (viii) ATTORNEY/AGENT INFORMATION:
  - (A) NAME: , PV&P R
  - (B) REGISTRATION NUMBER:
  - (C) REFERENCE/DOCKET NUMBER:

(2) INFORMATION FOR SEQ ID NO:1:

- (i) SEQUENCE CHARACTERISTICS:
  - (A) LENGTH: 53 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

TTGGACACAA GCTTTGGACA CGGCGCGCCA TGAGTAAAGG AGAAGAAGTT TTC

53

(2) INFORMATION FOR SEQ ID NO:2:

- (i) SEQUENCE CHARACTERISTICS:
  - (A) LENGTH: 53 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

GTCATCTTCT CGAGTCTTAC TCCTGAGGTT TGTATAGTTC ATCCATGCCA TGT

53

(2) INFORMATION FOR SEQ ID NO:3:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 54 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:3:

TTGGACACAA GCTTTGGACA CCCTCAGGAT ATGGGCAACG CCGCCGCCGC CAAG

54

(2) INFORMATION FOR SEQ ID NO:4:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 55 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:4:

GTCATCTTCT CGAGTCTTTC AGGCGCGCCC AAATCAGTA AACTCCTTGC CACAC

55

(2) INFORMATION FOR SEQ ID NO:5:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 55 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:5:

TTGGACACAA GCTTTGGACA CCCTCAGGAT ATGGCTGACG TTTACCCGGC CAACG

55

(2) INFORMATION FOR SEQ ID NO:6:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 55 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:6:

GTCATCTTCT CGAGTCTTTC AGGCGCGCCC TACTGCACTT TGCAAGATTG GGTGC

55

(2) INFORMATION FOR SEQ ID NO:7:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 64 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:7:

TTGGACACAA GCTTTGGACA CCCTCAGGAT ATGGCGGCGG CGGCGGCGGC TCCGGGGGGC 60  
GGGG 64

(2) INFORMATION FOR SEQ ID NO:8:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 55 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:8:

GTCATCTTCT CGAGTCTTTC AGGCGCGCCC GGGGCCCTCT GGC GCCCTG GCTGG 55

(2) INFORMATION FOR SEQ ID NO:9:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:9:

TAGAATTCAA CCATGGCGGC GCGGCGGCG 30

(2) INFORMATION FOR SEQ ID NO:10:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 29 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:10:

TAGGATCCCT AGGGGGCCTC CAGCACTCC 29

(2) INFORMATION FOR SEQ ID NO:11:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:11:

TACTCGAGTA ACCATGGCGG CGGCGGCGGC G

31

(2) INFORMATION FOR SEQ ID NO:12:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 25 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:12:

TAGGATCCAT AGATCTGTAT CCTGG

25

(2) INFORMATION FOR SEQ ID NO:13:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 26 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:13:

TAGGATCCTT AAGATCTGTA TCCTGG

26

(2) INFORMATION FOR SEQ ID NO:14:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:14:

ATCTCGAGGG AAAATGTCTC AGGAGAGG

28

(2) INFORMATION FOR SEQ ID NO:15:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:15:

ATGGATCCTC GGACTCCATC TCTTCTTG

28

(2) INFORMATION FOR SEQ ID NO:16:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 29 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:16:

ATGGATCCTC AGGACTCCAT CTCTTCTTG

29

(2) INFORMATION FOR SEQ ID NO:17:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:17:

GTCTCGAGCC ATCATGAGCA GAAGCAAG

28

(2) INFORMATION FOR SEQ ID NO:18:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:18:

GTGGATCCCA CTGCTGCACC TGTGCTA

27

(2) INFORMATION FOR SEQ ID NO:19:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:19:

GTGGATCCTC ACTGCTGCAC CTGTGCTA

28

(2) INFORMATION FOR SEQ ID NO:20:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 40 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:20:

CGCGAATTCC GCCACCATGA GTGCTGAGGG GTACCAGTAC

40

(2) INFORMATION FOR SEQ ID NO:21:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 32 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:21:

CGCGGATCCT GTCGCCTCTG CTGTGCATAT AC

32

(2) INFORMATION FOR SEQ ID NO:22:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: p85-top-C

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:22:

GGGAGATCTA TGAGTGCTGA GGGGTACCAG

30

(2) INFORMATION FOR SEQ ID NO:23:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 34 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:23:

GGGCGGATCC TCATCGCCTC TGCTGTGCAT ATAC

34

(2) INFORMATION FOR SEQ ID NO:24:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 33 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:24:

GTGAATTCGA CCATGTCGTC CATCTTGCCA TTC

33

(2) INFORMATION FOR SEQ ID NO:25:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:25:

GTGGTACCCA TGACATGCTT GAGCAACGCA C

31

(2) INFORMATION FOR SEQ ID NO:26:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 32 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:26:

GTGGTACCTT ATGACATGCT TGAGCAACGC AC

32

(2) INFORMATION FOR SEQ ID NO:27:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:27:

GTGAATTCGT CAATGGAGCT GGAAAACATC G

31

(2) INFORMATION FOR SEQ ID NO:28:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:28:

GTGGATCCCT GCTGCTCCG GTGGAGTTCG

30

(2) INFORMATION FOR SEQ ID NO:29:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs

- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:29:

GTGGATCCCT AGCTGCTTCC GGTGGAGTTC G

31

(2) INFORMATION FOR SEQ ID NO:30:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 32 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:30:

GTAGATCTAC CATGGCGGGC TGGATCCAGG CC

32

(2) INFORMATION FOR SEQ ID NO:31:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:31:

GTGGTACCCA TGAGAGGGAG CCTCTGGCAG A

31

(2) INFORMATION FOR SEQ ID NO:32:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:32:

GTGGTACCTC ATGAGAGGGA GCCTCTGGCA G

31

(2) INFORMATION FOR SEQ ID NO:33:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 33 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:33:



GTGAATTCAA CCATGGACAA TATGTCTATT ACG

33

(2) INFORMATION FOR SEQ ID NO:34:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:34:

GTGGATCCCA GTCTAAAGGT TGTGGGTCTG C

31

(2) INFORMATION FOR SEQ ID NO:35:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 32 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:35:

GTGGATCCTC AGTCTAAAGG TTGTGGGTCT GC

32

(2) INFORMATION FOR SEQ ID NO:36:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:36:

GTCTCGAGGC ACCATGAGCG ACGTGGC

27

(2) INFORMATION FOR SEQ ID NO:37:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:37:

TGGGATCCGA GGCCGTGCTG CTGGCCG

27

(2) INFORMATION FOR SEQ ID NO:38:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 1896 base pairs  
 (B) TYPE: nucleic acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA  
 (ix) FEATURE:

(A) NAME/KEY: Coding Sequence  
 (B) LOCATION: 1...1891  
 (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:38:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65 70 75 80	
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG	288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85 90 95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG	336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu	
100 105 110	
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC	384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly	
115 120 125	
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC	432
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr	
130 135 140	
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC	480
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn	
145 150 155 160	
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC	528
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser	
165 170 175	

GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GCT CAA GCT TCG AAT TCA ACC ATG GCG GCG GCG Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Thr Met Ala Ala Ala 245 250 255	768
GCG GCT CAG GGG GGC GGG GGC GGG GAG CCC CGT AGA ACC GAG GGG GTC Ala Ala Gln Gly Gly Gly Gly Gly Glu Pro Arg Arg Thr Glu Gly Val 260 265 270	816
GGC CCG GGG GTC CCG GGG GAG GTG GAG ATG GTG AAG GGG CAG CCG TTC Gly Pro Gly Val Pro Gly Glu Val Glu Met Val Lys Gly Gln Pro Phe 275 280 285	864
GAC GTG GGC CCG CGC TAC ACG CAG TTG CAG TAC ATC GGC GAG GGC GCG Asp Val Gly Pro Arg Tyr Thr Gln Leu Gln Tyr Ile Gly Glu Gly Ala 290 295 300	912
TAC GGC ATG GTC AGC TCG GCC TAT GAC CAC GTG CGC AAG ACT CGC GTG Tyr Gly Met Val Ser Ser Ala Tyr Asp His Val Arg Lys Thr Arg Val 305 310 315 320	960
GCC ATC AAG AAG ATC AGC CCC TTC GAA CAT CAG ACC TAC TGC CAG CGC Ala Ile Lys Lys Ile Ser Pro Phe Glu His Gln Thr Tyr Cys Gln Arg 325 330 335	1008
ACG CTC CGG GAG ATC CAG ATC CTG CTG CGC TTC CGC CAT GAG AAT GTC Thr Leu Arg Glu Ile Gln Ile Leu Leu Arg Phe Arg His Glu Asn Val 340 345 350	1056
ATC GGC ATC CGA GAC ATT CTG CGG GCG TCC ACC CTG GAA GCC ATG AGA Ile Gly Ile Arg Asp Ile Leu Arg Ala Ser Thr Leu Glu Ala Met Arg 355 360 365	1104
GAT GTC TAC ATT GTG CAG GAC CTG ATG GAG ACT GAC CTG TAC AAG TTG Asp Val Tyr Ile Val Gln Asp Leu Met Glu Thr Asp Leu Tyr Lys Leu 370 375 380	1152
CTG AAA AGC CAG CAG CTG AGC AAT GAC CAT ATC TGC TAC TTC CTC TAC Leu Lys Ser Gln Gln Leu Ser Asn Asp His Ile Cys Tyr Phe Leu Tyr 385 390 395 400	1200
CAG ATC CTG CGG GGC CTC AAG TAC ATC CAC TCC GCC AAC GTG CTC CAC Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser Ala Asn Val Leu His	1248

405	410	415	
CGA GAT CTA AAG CCC TCC AAC CTG CTC AGC AAC ACC ACC TGC GAC CTT			1296
Arg Asp Leu Lys Pro Ser Asn Leu Leu Ser Asn Thr Thr Cys Asp Leu			
420	425	430	
AAG ATT TGT GAT TTC GGC CTG GCC CGG ATT GCC GAT CCT GAG CAT GAC			1344
Lys Ile Cys Asp Phe Gly Leu Ala Arg Ile Ala Asp Pro Glu His Asp			
435	440	445	
CAC ACC GGC TTC CTG ACG GAG TAT GTG GCT ACG CGC TGG TAC CGG GCC			1392
His Thr Gly Phe Leu Thr Glu Tyr Val Ala Thr Arg Trp Tyr Arg Ala			
450	455	460	
CCA GAG ATC ATG CTG AAC TCC AAG GGC TAT ACC AAG TCC ATC GAC ATC			1440
Pro Glu Ile Met Leu Asn Ser Lys Gly Tyr Thr Lys Ser Ile Asp Ile			
465	470	475	480
TGG TCT GTG GGC TGC ATT CTG GCT GAG ATG CTC TCT AAC CGG CCC ATC			1488
Trp Ser Val Gly Cys Ile Leu Ala Glu Met Leu Ser Asn Arg Pro Ile			
485	490	495	
TTC CCT GGC AAG CAC TAC CTG GAT CAG CTC AAC CAC ATT CTG GGC ATC			1536
Phe Pro Gly Lys His Tyr Leu Asp Gln Leu Asn His Ile Leu Gly Ile			
500	505	510	
CTG GGC TCC CCA TCC CAG GAG GAC CTG AAT TGT ATC ATC AAC ATG AAG			1584
Leu Gly Ser Pro Ser Gln Glu Asp Leu Asn Cys Ile Ile Asn Met Lys			
515	520	525	
GCC CGA AAC TAC CTA CAG TCT CTG CCC TCC AAG ACC AAG GTG GCT TGG			1632
Ala Arg Asn Tyr Leu Gln Ser Leu Pro Ser Lys Thr Lys Val Ala Trp			
530	535	540	
GCC AAG CTT TTC CCC AAG TCA GAC TCC AAA GCC CTT GAC CTG CTG GAC			1680
Ala Lys Leu Phe Pro Lys Ser Asp Ser Lys Ala Leu Asp Leu Leu Asp			
545	550	555	560
CGG ATG TTA ACC TTT AAC CCC AAT AAA CGG ATC ACA GTG GAG GAA GCG			1728
Arg Met Leu Thr Phe Asn Pro Asn Lys Arg Ile Thr Val Glu Glu Ala			
565	570	575	
CTG GCT CAC CCC TAC CTG GAG CAG TAC TAT GAC CCG ACG GAT GAG CCA			1776
Leu Ala His Pro Tyr Leu Glu Gln Tyr Tyr Asp Pro Thr Asp Glu Pro			
580	585	590	
GTG GCC GAG GAG CCC TTC ACC TTC GCC ATG GAG CTG GAT GAC CTA CCT			1824
Val Ala Glu Glu Pro Phe Thr Phe Ala Met Glu Leu Asp Asp Leu Pro			
595	600	605	
AAG GAG CGG CTG AAG GAG CTC ATC TTC CAG GAG ACA GCA CGC TTC CAG			1872
Lys Glu Arg Leu Lys Glu Leu Ile Phe Gln Glu Thr Ala Arg Phe Gln			
610	615	620	
CCC GGA GTG CTG GAG GCC C C CCTAG			1896
Pro Gly Val Leu Glu Ala Pro			
625	630		

## (2) INFORMATION FOR SEQ ID NO:39:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 631 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:39:

```

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
 1          5          10          15
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
      20          25          30
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
      35          40          45
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
      50          55          60
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
      65          70          75          80
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu
      85          90          95
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu
      100         105         110
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly
      115         120         125
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr
      130         135         140
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn
      145         150         155         160
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser
      165         170         175
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly
      180         185         190
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu
      195         200         205
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe
      210         215         220
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser
      225         230         235         240
Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Thr Met Ala Ala Ala
      245         250         255
Ala Ala Gln Gly Gly Gly Gly Gly Glu Pro Arg Arg Thr Glu Gly Val
      260         265         270
Gly Pro Gly Val Pro Gly Glu Val Glu Met Val Lys Gly Gln Pro Phe
      275         280         285
Asp Val Gly Pro Arg Tyr Thr Gln Leu Gln Tyr Ile Gly Glu Gly Ala
      290         295         300
Tyr Gly Met Val Ser Ser Ala Tyr Asp His Val Arg Lys Thr Arg Val
      305         310         315         320
Ala Ile Lys Lys Ile Ser Pro Phe Glu His Gln Thr Tyr Cys Gln Arg
      325         330         335
Thr Leu Arg Glu Ile Gln Ile Leu Leu Arg Phe Arg His Glu Asn Val
      340         345         350

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Ile Gly Ile Arg Asp Ile Leu Arg Ala Ser Thr Leu Glu Ala Met Arg
    355                360                365
Asp Val Tyr Ile Val Gln Asp Leu Met Glu Thr Asp Leu Tyr Lys Leu
    370                375                380
Leu Lys Ser Gln Gln Leu Ser Asn Asp His Ile Cys Tyr Phe Leu Tyr
    385                390                395                400
Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser Ala Asn Val Leu His
    405                410                415
Arg Asp Leu Lys Pro Ser Asn Leu Leu Ser Asn Thr Thr Cys Asp Leu
    420                425                430
Lys Ile Cys Asp Phe Gly Leu Ala Arg Ile Ala Asp Pro Glu His Asp
    435                440                445
His Thr Gly Phe Leu Thr Glu Tyr Val Ala Thr Arg Trp Tyr Arg Ala
    450                455                460
Pro Glu Ile Met Leu Asn Ser Lys Gly Tyr Thr Lys Ser Ile Asp Ile
    465                470                475                480
Trp Ser Val Gly Cys Ile Leu Ala Glu Met Leu Ser Asn Arg Pro Ile
    485                490                495
Phe Pro Gly Lys His Tyr Leu Asp Gln Leu Asn His Ile Leu Gly Ile
    500                505                510
Leu Gly Ser Pro Ser Gln Glu Asp Leu Asn Cys Ile Ile Asn Met Lys
    515                520                525
Ala Arg Asn Tyr Leu Gln Ser Leu Pro Ser Lys Thr Lys Val Ala Trp
    530                535                540
Ala Lys Leu Phe Pro Lys Ser Asp Ser Lys Ala Leu Asp Leu Leu Asp
    545                550                555                560
Arg Met Leu Thr Phe Asn Pro Asn Lys Arg Ile Thr Val Glu Glu Ala
    565                570                575
Leu Ala His Pro Tyr Leu Glu Gln Tyr Tyr Asp Pro Thr Asp Glu Pro
    580                585                590
Val Ala Glu Glu Pro Phe Thr Phe Ala Met Glu Leu Asp Asp Leu Pro
    595                600                605
Lys Glu Arg Leu Lys Glu Leu Ile Phe Gln Glu Thr Ala Arg Phe Gln
    610                615                620
Pro Gly Val Leu Glu Ala Pro
    625                630

```

## (2) INFORMATION FOR SEQ ID NO:40:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1818 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1815
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:40:

```

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
  1             5             10             15

```

GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly 20 25 30	96
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile 35 40 45	144
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr 50 55 60	192
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys 65 70 75 80	240
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu 85 90 95	288
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu 100 105 110	336
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125	384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GTA ACC ATG GCG GCG GCG GCG GCG GCG GCG CCG Gly Leu Arg Ser Arg Val Thr Met Ala Ala Ala Ala Ala Ala Gly Pro	768

245	250	255	
GAG ATG GTC CGC GGG CAG GTG TTC GAC GTG GGG CCG CGC TAC ACT AAT Glu Met Val Arg Gly Gln Val Phe Asp Val Gly Pro Arg Tyr Thr Asn 260 265 270			816
CTC TCG TAC ATC GGA GAA GGC GCC TAC GGC ATG GTT TGT TCT GCT TAT Leu Ser Tyr Ile Gly Glu Gly Ala Tyr Gly Met Val Cys Ser Ala Tyr 275 280 285			864
GAT AAT CTC AAC AAA GTT CGA GTT GCT ATC AAG AAA ATC AGT CCT TTT Asp Asn Leu Asn Lys Val Arg Val Ala Ile Lys Lys Ile Ser Pro Phe 290 295 300			912
GAG CAC CAG ACC TAC TGT CAG AGA ACC CTG AGA GAG ATA AAA ATC CTA Glu His Gln Thr Tyr Cys Gln Arg Thr Leu Arg Glu Ile Lys Ile Leu 305 310 315 320			960
CTG CGC TTC AGA CAT GAG AAC ATC ATC GGC ATC AAT GAC ATC ATC CGG Leu Arg Phe Arg His Glu Asn Ile Ile Gly Ile Asn Asp Ile Ile Arg 325 330 335			1008
GCA CCA ACC ATT GAG CAG ATG AAA GAT GTA TAT ATA GTA CAG GAC CTC Ala Pro Thr Ile Glu Gln Met Lys Asp Val Tyr Ile Val Gln Asp Leu 340 345 350			1056
ATG GAG ACA GAT CTT TAC AAG CTC TTG AAG ACA CAG CAC CTC AGC AAT Met Glu Thr Asp Leu Tyr Lys Leu Leu Lys Thr Gln His Leu Ser Asn 355 360 365			1104
GAT CAT ATC TGC TAT TTT CTT TAT CAG ATC CTG AGA GGA TTA AAG TAT Asp His Ile Cys Tyr Phe Leu Tyr Gln Ile Leu Arg Gly Leu Lys Tyr 370 375 380			1152
ATA CAT TCA GCT AAT GTT CTG CAC CGT GAC CTC AAG CCT TCC AAC CTC Ile His Ser Ala Asn Val Leu His Arg Asp Leu Lys Pro Ser Asn Leu 385 390 395 400			1200
CTG CTG AAC ACC ACT TGT GAT CTC AAG ATC TGT GAC TTT GGC CTT GCC Leu Leu Asn Thr Thr Cys Asp Leu Lys Ile Cys Asp Phe Gly Leu Ala 405 410 415			1248
CGT GTT GCA GAT CCA GAC CAT GAT CAT ACA GGG TTC TTG ACA GAG TAT Arg Val Ala Asp Pro Asp His Asp His Thr Gly Phe Leu Thr Glu Tyr 420 425 430			1296
GTA GCC ACG CGT TGG TAC AGA GCT CCA GAA ATT ATG TTG AAT TCC AAG Val Ala Thr Arg Trp Tyr Arg Ala Pro Glu Ile Met Leu Asn Ser Lys 435 440 445			1344
GGT TAT ACC AAG TCC ATT GAT ATT TGG TCT GTG GGC TGC ATC CTG GCA Gly Tyr Thr Lys Ser Ile Asp Ile Trp Ser Val Gly Cys Ile Leu Ala 450 455 460			1392
GAG ATG CTA TCC AAC AGG CCT ATC TTC CCA GGA AAG CAT TAC CTT GAC Glu Met Leu Ser Asn Arg Pro Ile Phe Pro Gly Lys His Tyr Leu Asp 465 470 475 480			1440



CAG CTG AAT CAC ATC CTG GGT ATT CTT GGA TCT CCA TCA CAG GAA GAT	1488
Gln Leu Asn His Ile Leu Gly Ile Leu Gly Ser Pro Ser Gln Glu Asp	
485 490 495	
CTG AAT TGT ATA ATA AAT TTA AAA GCT AGA AAC TAT TTG CTT TCT CTC	1536
Leu Asn Cys Ile Ile Asn Leu Lys Ala Arg Asn Tyr Leu Leu Ser Leu	
500 505 510	
CCG CAC AAA AAT AAG GTG CCG TGG AAC AGG TTG TTC CCA AAC GCT GAC	1584
Pro His Lys Asn Lys Val Pro Trp Asn Arg Leu Phe Pro Asn Ala Asp	
515 520 525	
TCC AAA GCT CTG GAT TTA CTG GAT AAA ATG TTG ACA TTT AAC CCT CAC	1632
Ser Lys Ala Leu Asp Leu Leu Asp Lys Met Leu Thr Phe Asn Pro His	
530 535 540	
AAG AGG ATT GAA GTT GAA CAG GCT CTG GCC CAC CCG TAC CTG GAG CAG	1680
Lys Arg Ile Glu Val Glu Gln Ala Leu Ala His Pro Tyr Leu Glu Gln	
545 550 555 560	
TAT TAT GAC CCA AGT GAT GAG CCC ATT GCT GAA GCA CCA TTC AAG TTT	1728
Tyr Tyr Asp Pro Ser Asp Glu Pro Ile Ala Glu Ala Pro Phe Lys Phe	
565 570 575	
GAC ATG GAG CTG GAC GAC TTA CCT AAG GAG AAG CTC AAA GAA CTC ATT	1776
Asp Met Glu Leu Asp Asp Leu Pro Lys Glu Lys Leu Lys Glu Leu Ile	
580 585 590	
TTT GAA GAG ACT GCT CGA TTC CAG CCA GGA TAC AGA TCT TAA	1818
Phe Glu Glu Thr Ala Arg Phe Gln Pro Gly Tyr Arg Ser	
595 600 605	

## (2) INFORMATION FOR SEQ ID NO:41:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 605 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:41:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65 70 75 80	
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85 90 95	

Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu  
 100 105 110  
 Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly  
 115 120 125  
 Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr  
 130 135 140  
 Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn  
 145 150 155 160  
 Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser  
 165 170 175  
 Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly  
 180 185 190  
 Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu  
 195 200 205  
 Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe  
 210 215 220  
 Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser  
 225 230 235 240  
 Gly Leu Arg Ser Arg Val Thr Met Ala Ala Ala Ala Ala Gly Pro  
 245 250 255  
 Glu Met Val Arg Gly Gln Val Phe Asp Val Gly Pro Arg Tyr Thr Asn  
 260 265 270  
 Leu Ser Tyr Ile Gly Glu Gly Ala Tyr Gly Met Val Cys Ser Ala Tyr  
 275 280 285  
 Asp Asn Leu Asn Lys Val Arg Val Ala Ile Lys Lys Ile Ser Pro Phe  
 290 295 300  
 Glu His Gln Thr Tyr Cys Gln Arg Thr Leu Arg Glu Ile Lys Ile Leu  
 305 310 315 320  
 Leu Arg Phe Arg His Glu Asn Ile Ile Gly Ile Asn Asp Ile Ile Arg  
 325 330 335  
 Ala Pro Thr Ile Glu Gln Met Lys Asp Val Tyr Ile Val Gln Asp Leu  
 340 345 350  
 Met Glu Thr Asp Leu Tyr Lys Leu Leu Lys Thr Gln His Leu Ser Asn  
 355 360 365  
 Asp His Ile Cys Tyr Phe Leu Tyr Gln Ile Leu Arg Gly Leu Lys Tyr  
 370 375 380  
 Ile His Ser Ala Asn Val Leu His Arg Asp Leu Lys Pro Ser Asn Leu  
 385 390 395 400  
 Leu Leu Asn Thr Thr Cys Asp Leu Lys Ile Cys Asp Phe Gly Leu Ala  
 405 410 415  
 Arg Val Ala Asp Pro Asp His Asp His Thr Gly Phe Leu Thr Glu Tyr  
 420 425 430  
 Val Ala Thr Arg Trp Tyr Arg Ala Pro Glu Ile Met Leu Asn Ser Lys  
 435 440 445  
 Gly Tyr Thr Lys Ser Ile Asp Ile Trp Ser Val Gly Cys Ile Leu Ala  
 450 455 460  
 Glu Met Leu Ser Asn Arg Pro Ile Phe Pro Gly Lys His Tyr Leu Asp  
 465 470 475 480  
 Gln Leu Asn His Ile Leu Gly Ile Leu Gly Ser Pro Ser Gln Glu Asp  
 485 490 495  
 Leu Asn Cys Ile Ile Asn Leu Lys Ala Arg Asn Tyr Leu Leu Ser Leu  
 500 505 510  
 Pro His Lys Asn Lys Val Pro Trp Asn Arg Leu Phe Pro Asn Ala Asp  
 515 520 525  
 Ser Lys Ala Leu Asp Leu Leu Asp Lys Met Leu Thr Phe Asn Pro His  
 530 535 540  
 Lys Arg Ile Glu Val Glu Gln Ala Leu Ala His Pro Tyr Leu Glu Gln  
 545 550 555 560

Tyr	Tyr	Asp	Pro	Ser	Asp	Glu	Pro	Ile	Ala	Glu	Ala	Pro	Phe	Lys	Phe
				565					570					575	
Asp	Met	Glu	Leu	Asp	Asp	Leu	Pro	Lys	Glu	Lys	Leu	Lys	Glu	Leu	Ile
			580					585					590		
Phe	Glu	Glu	Thr	Ala	Arg	Phe	Gln	Pro	Gly	Tyr	Arg	Ser			
		595					600					605			

(2) INFORMATION FOR SEQ ID NO:42:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2529 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...2526  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:42:

ATG Met 1	GTG Val	AGC Ser	AAG Lys	GGC Gly 5	GAG Glu	GAG Glu	CTG Leu	TTC Phe	ACC Thr 10	GGG Gly	GTG Val	GTG Val	CCC Pro	ATC Ile 15	CTG Leu	48
GTC Val	GAG Glu	CTG Leu	GAC Asp 20	GGC Gly	GAC Asp	GTA Val	AAC Asn 25	GGC Gly	CAC His	AAG Lys	TTC Phe	AGC Ser 30	GTG Val	TCC Ser	GGC Gly	96
GAG Glu	GGC Gly 35	GAG Glu	GGC Gly	GAT Asp	GCC Ala	ACC Thr	TAC Tyr 40	GGC Gly	AAG Lys	CTG Leu	ACC Thr	CTG Leu 45	AAG Lys	TTC Phe	ATC Ile	144
TGC Cys 50	ACC Thr	ACC Thr	GGC Gly	AAG Lys	CTG Leu	CCC Pro 55	GTG Val	CCC Pro	TGG Trp	CCC Pro	ACC Thr 60	CTC Leu	GTG Val	ACC Thr	ACC Thr	192
CTG Leu 65	ACC Thr	TAC Tyr	GGC Gly	GTG Val 70	CAG Gln	TGC Cys	TTC Phe	AGC Ser	CGC Arg 75	TAC Tyr	CCC Pro	GAC Asp	CAC His	ATG Met 80	AAG Lys	240
CAG Gln	CAC His	GAC Asp	TTC Phe 85	TTC Phe	AAG Lys	TCC Ser	GCC Ala	ATG Met	CCC Pro 90	GAA Glu	GGC Gly	TAC Tyr	GTG Val	CAG Gln 95	GAG Glu	288
CGC Arg	ACC Thr	ATC Ile 100	TTC Phe	TTC Phe	AAG Lys	GAC Asp	GAC Asp	GGC Gly 105	AAC Asn	TAC Tyr	AAG Lys	ACC Thr 110	CGC Arg	GCC Ala	GAG Glu	336
GTG Val	AAG Lys 115	TTC Phe	GAG Glu	GGC Gly	GAC Asp	ACC Thr	CTG Leu 120	GTG Val	AAC Asn	CGC Arg	ATC Ile 125	GAG Glu 125	CTG Leu	AAG Lys	GGC Gly	384
ATC Ile	GAC Asp	TTC Phe	AAG Lys	GAG Glu	GAC Asp	GGC Gly	AAC Asn	ATC Ile	CTG Leu	GGG Gly	CAC His	AAG Lys	CTG Leu	GAG Glu	TAC Tyr	432

130	135	140	
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160			480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175			528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190			576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205			624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220			672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240			720
GGA CTC AGA TCT CGA GCT CAA GCT TCG AAT TCG TCA ATG GAG CTG GAA Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Ser Met Glu Leu Glu 245 250 255			768
AAC ATC GTG GCC AAC ACG GTC TTG CTG AAA GCC AGG GAA GGG GGC GGA Asn Ile Val Ala Asn Thr Val Leu Leu Lys Ala Arg Glu Gly Gly Gly 260 265 270			816
GGA AAG CGC AAA GGG AAA AGC AAG AAG TGG AAA GAA ATC CTG AAG TTC Gly Lys Arg Lys Gly Lys Ser Lys Lys Trp Lys Glu Ile Leu Lys Phe 275 280 285			864
CCT CAC ATT AGC CAG TGT GAA GAC CTC CGA AGG ACC ATA GAC AGA GAT Pro His Ile Ser Gln Cys Glu Asp Leu Arg Arg Thr Ile Asp Arg Asp 290 295 300			912
TAC TGC AGT TTA TGT GAC AAG CAG CCA ATC GGG AGG CTG CTT TTC CGG Tyr Cys Ser Leu Cys Asp Lys Gln Pro Ile Gly Arg Leu Leu Phe Arg 305 310 315 320			960
CAG TTT TGT GAA ACC AGG CCT GGG CTG GAG TGT TAC ATT CAG TTC CTG Gln Phe Cys Glu Thr Arg Pro Gly Leu Glu Cys Tyr Ile Gln Phe Leu 325 330 335			1008
GAC TCC GTG GCA GAA TAT GAA GTT ACT CCA GAT GAA AAA CTG GGA GAG Asp Ser Val Ala Glu Tyr Glu Val Thr Pro Asp Glu Lys Leu Gly Glu 340 345 350			1056
AAA GGG AAG GAA ATT ATG ACC AAG TAC CTC ACC CCA AAG TCC CCT GTT Lys Gly Lys Glu Ile Met Thr Lys Tyr Leu Thr Pro Lys Ser Pro Val 355 360 365			1104

TTC ATA GCC CAA GTT GGC CAA GAC CTG GTC TCC CAG ACG GAG GAG AAG	1152
Phe Ile Ala Gln Val Gly Gln Asp Leu Val Ser Gln Thr Glu Glu Lys	
370 375 380	
CTC CTA CAG AAG CCG TGC AAA GAA CTC TTT TCT GCC TGT GCA CAG TCT	1200
Leu Leu Gln Lys Pro Cys Lys Glu Leu Phe Ser Ala Cys Ala Gln Ser	
385 390 395 400	
GTC CAC GAG TAC CTG AGG GGA GAA CCA TTC CAC GAA TAT CTG GAC AGC	1248
Val His Glu Tyr Leu Arg Gly Glu Pro Phe His Glu Tyr Leu Asp Ser	
405 410 415	
ATG TTT TTT GAC CGC TTT CTC CAG TGG AAG TGG TTG GAA AGG CAA CCG	1296
Met Phe Phe Asp Arg Phe Leu Gln Trp Lys Trp Leu Glu Arg Gln Pro	
420 425 430	
GTG ACC AAA AAC ACT TTC AGG CAG TAT CGA GTG CTA GGA AAA GGG GGC	1344
Val Thr Lys Asn Thr Phe Arg Gln Tyr Arg Val Leu Gly Lys Gly Gly	
435 440 445	
TTC GGG GAG GTC TGT GCC TGC CAG GTT CGG GCC ACG GGT AAA ATG TAT	1392
Phe Gly Glu Val Cys Ala Cys Gln Val Arg Ala Thr Gly Lys Met Tyr	
450 455 460	
GCC TGC AAG CGC TTG GAG AAG AAG AGG ATC AAA AAG AGG AAA GGG GAG	1440
Ala Cys Lys Arg Leu Glu Lys Lys Arg Ile Lys Lys Arg Lys Gly Glu	
465 470 475 480	
TCC ATG GCC CTC AAT GAG AAG CAG ATC CTC GAG AAG GTC AAC AGT CAG	1488
Ser Met Ala Leu Asn Glu Lys Gln Ile Leu Glu Lys Val Asn Ser Gln	
485 490 495	
TTT GTG GTC AAC CTG GCC TAT GCC TAC GAG ACC AAG GAT GCA CTG TGC	1536
Phe Val Val Asn Leu Ala Tyr Ala Tyr Glu Thr Lys Asp Ala Leu Cys	
500 505 510	
TTG GTC CTG ACC ATC ATG AAT GGG GGT GAC CTG AAG TTC CAC ATC TAC	1584
Leu Val Leu Thr Ile Met Asn Gly Gly Asp Leu Lys Phe His Ile Tyr	
515 520 525	
AAC ATG GGC AAC CCT GGC TTC GAG GAG GAG CGG GCC TTG TTT TAT GCG	1632
Asn Met Gly Asn Pro Gly Phe Glu Glu Glu Arg Ala Leu Phe Tyr Ala	
530 535 540	
GCA GAG ATC CTC TGC GGC TTA GAA GAC CTC CAC CGT GAG AAC ACC GTC	1680
Ala Glu Ile Leu Cys Gly Leu Glu Asp Leu His Arg Glu Asn Thr Val	
545 550 555 560	
TAC CGA GAT CTG AAA CCT GAA AAC ATC CTG TTA GAT GAT TAT GGC CAC	1728
Tyr Arg Asp Leu Lys Pro Glu Asn Ile Leu Leu Asp Asp Tyr Gly His	
565 570 575	
ATT AGG ATC TCA GAC CTG GGC TTG GCT GTG AAG ATC CCC GAG GGA GAC	1776
Ile Arg Ile Ser Asp Leu Gly Leu Ala Val Lys Ile Pro Glu Gly Asp	
580 585 590	
CTG ATC CGC GGC CGG GTG GGC ACT GTT GGC TAC ATG GCC CCC GAA GTC	1824
Leu Ile Arg Gly Arg Val Gly Thr Val Gly Tyr Met Ala Pro Glu Val	

595	600	605	
CTG AAC AAC CAG AGG TAC GGC CTG AGC CCC GAC TAC TGG GGC CTT GGC Leu Asn Asn Gln Arg Tyr Gly Leu Ser Pro Asp Tyr Trp Gly Leu Gly 610 615 620			1872
TGC CTC ATC TAT GAG ATG ATC GAG GGC CAG TCG CCG TTC CGC GGC CGT Cys Leu Ile Tyr Glu Met Ile Glu Gly Gln Ser Pro Phe Arg Gly Arg 625 630 635 640			1920
AAG GAG AAG GTG AAG CCG GAG GAG GTG GAC CGC CCG GTC CTG GAG ACG Lys Glu Lys Val Lys Arg Glu Glu Val Asp Arg Arg Val Leu Glu Thr 645 650 655			1968
GAG GAG GTG TAC TCC CAC AAG TTC TCC GAG GAG GCC AAG TCC ATC TGC Glu Glu Val Tyr Ser His Lys Phe Ser Glu Glu Ala Lys Ser Ile Cys 660 665 670			2016
AAG ATG CTG CTC ACG AAA GAT GCG AAG CAG AGG CTG GGC TGC CAG GAG Lys Met Leu Leu Thr Lys Asp Ala Lys Gln Arg Leu Gly Cys Gln Glu 675 680 685			2064
GAG GGG GCT GCA GAG GTC AAG AGA CAC CCC TTC TTC AGG AAC ATG AAC Glu Gly Ala Ala Glu Val Lys Arg His Pro Phe Phe Arg Asn Met Asn 690 695 700			2112
TTC AAG CGC TTA GAA GCC GGG ATG TTG GAC CCT CCC TTC GTT CCA GAC Phe Lys Arg Leu Glu Ala Gly Met Leu Asp Pro Pro Phe Val Pro Asp 705 710 715 720			2160
CCC CGC GCT GTG TAC TGT AAG GAC GTG CTG GAC ATC GAG CAG TTC TCC Pro Arg Ala Val Tyr Cys Lys Asp Val Leu Asp Ile Glu Gln Phe Ser 725 730 735			2208
ACT GTG AAG GGC GTC AAT CTG GAC CAC ACA GAC GAC GAC TTC TAC TCC Thr Val Lys Gly Val Asn Leu Asp His Thr Asp Asp Asp Phe Tyr Ser 740 745 750			2256
AAG TTC TCC ACG GGC TCT GTG TCC ATC CCA TGG CAA AAC GAG ATG ATA Lys Phe Ser Thr Gly Ser Val Ser Ile Pro Trp Gln Asn Glu Met Ile 755 760 765			2304
GAA ACA GAA TGC TTT AAG GAG CTG AAC GTG TTT GGA CCT AAT GGT ACC Glu Thr Glu Cys Phe Lys Glu Leu Asn Val Phe Gly Pro Asn Gly Thr 770 775 780			2352
CTC CCG CCA GAT CTG AAC AGA AAC CAC CCT CCG GAA CCG CCC AAG AAA Leu Pro Pro Asp Leu Asn Arg Asn His Pro Pro Glu Pro Pro Lys Lys 785 790 795 800			2400
GGG CTG CTC CAG AGA CTC TTC AAG CGG CAG CAT CAG AAC AAT TCC AAG Gly Leu Leu Gln Arg Leu Phe Lys Arg Gln His Gln Asn Asn Ser Lys 805 810 815			2448
AGT TCG CCC AGC TCC AAG ACC AGT TTT AAC CAC CAC ATA AAC TCA AAC Ser Ser Pro Ser Ser Lys Thr Ser Phe Asn His His Ile Asn Ser Asn 820 825 830			2496

CAT GTC AGC TCG AAC TCC ACC GGA AGC AGC TAG  
 His Val Ser Ser Asn Ser Thr Gly Ser Ser  
           835                              840

2529

## (2) INFORMATION FOR SEQ ID NO:43:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 842 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:43:

Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	1	5	10	15
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	20	25	30	
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	35	40	45	
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	50	55	60	
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	65	70	75	80
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	85	90	95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	100	105	110	
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	115	120	125	
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	130	135	140	
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	145	150	155	160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	165	170	175	
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	180	185	190	
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	195	200	205	
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	210	215	220	
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	225	230	235	240
Gly	Leu	Arg	Ser	Arg	Ala	Gln	Ala	Ser	Asn	Ser	Ser	Met	Glu	Leu	Glu	245	250	255	
Asn	Ile	Val	Ala	Asn	Thr	Val	Leu	Leu	Lys	Ala	Arg	Glu	Gly	Gly	Gly	260	265	270	
Gly	Lys	Arg	Lys	Gly	Lys	Ser	Lys	Lys	Trp	Lys	Glu	Ile	Leu	Lys	Phe	275	280	285	
Pro	His	Ile	Ser	Gln	Cys	Glu	Asp	Leu	Arg	Arg	Thr	Ile	Asp	Arg	Asp	290	295	300	
Tyr	Cys	Ser	Leu	Cys	Asp	Lys	Gln	Pro	Ile	Gly	Arg	Leu	Leu	Phe	Arg	305	310	315	320

Gln Phe Cys Glu Thr Arg Pro Gly Leu Glu Cys Tyr Ile Gln Phe Leu  
 325 330 335  
 Asp Ser Val Ala Glu Tyr Glu Val Thr Pro Asp Glu Lys Leu Gly Glu  
 340 345 350  
 Lys Gly Lys Glu Ile Met Thr Lys Tyr Leu Thr Pro Lys Ser Pro Val  
 355 360 365  
 Phe Ile Ala Gln Val Gly Gln Asp Leu Val Ser Gln Thr Glu Glu Lys  
 370 375 380  
 Leu Leu Gln Lys Pro Cys Lys Glu Leu Phe Ser Ala Cys Ala Gln Ser  
 385 390 395 400  
 Val His Glu Tyr Leu Arg Gly Glu Pro Phe His Glu Tyr Leu Asp Ser  
 405 410 415  
 Met Phe Phe Asp Arg Phe Leu Gln Trp Lys Trp Leu Glu Arg Gln Pro  
 420 425 430  
 Val Thr Lys Asn Thr Phe Arg Gln Tyr Arg Val Leu Gly Lys Gly Gly  
 435 440 445  
 Phe Gly Glu Val Cys Ala Cys Gln Val Arg Ala Thr Gly Lys Met Tyr  
 450 455 460  
 Ala Cys Lys Arg Leu Glu Lys Lys Arg Ile Lys Lys Arg Lys Gly Glu  
 465 470 475 480  
 Ser Met Ala Leu Asn Glu Lys Gln Ile Leu Glu Lys Val Asn Ser Gln  
 485 490 495  
 Phe Val Val Asn Leu Ala Tyr Ala Tyr Glu Thr Lys Asp Ala Leu Cys  
 500 505 510  
 Leu Val Leu Thr Ile Met Asn Gly Gly Asp Leu Lys Phe His Ile Tyr  
 515 520 525  
 Asn Met Gly Asn Pro Gly Phe Glu Glu Glu Arg Ala Leu Phe Tyr Ala  
 530 535 540  
 Ala Glu Ile Leu Cys Gly Leu Glu Asp Leu His Arg Glu Asn Thr Val  
 545 550 555 560  
 Tyr Arg Asp Leu Lys Pro Glu Asn Ile Leu Leu Asp Asp Tyr Gly His  
 565 570 575  
 Ile Arg Ile Ser Asp Leu Gly Leu Ala Val Lys Ile Pro Glu Gly Asp  
 580 585 590  
 Leu Ile Arg Gly Arg Val Gly Thr Val Gly Tyr Met Ala Pro Glu Val  
 595 600 605  
 Leu Asn Asn Gln Arg Tyr Gly Leu Ser Pro Asp Tyr Trp Gly Leu Gly  
 610 615 620  
 Cys Leu Ile Tyr Glu Met Ile Glu Gly Gln Ser Pro Phe Arg Gly Arg  
 625 630 635 640  
 Lys Glu Lys Val Lys Arg Glu Glu Val Asp Arg Arg Val Leu Glu Thr  
 645 650 655  
 Glu Glu Val Tyr Ser His Lys Phe Ser Glu Glu Ala Lys Ser Ile Cys  
 660 665 670  
 Lys Met Leu Leu Thr Lys Asp Ala Lys Gln Arg Leu Gly Cys Gln Glu  
 675 680 685  
 Glu Gly Ala Ala Glu Val Lys Arg His Pro Phe Phe Arg Asn Met Asn  
 690 695 700  
 Phe Lys Arg Leu Glu Ala Gly Met Leu Asp Pro Pro Phe Val Pro Asp  
 705 710 715 720  
 Pro Arg Ala Val Tyr Cys Lys Asp Val Leu Asp Ile Glu Gln Phe Ser  
 725 730 735  
 Thr Val Lys Gly Val Asn Leu Asp His Thr Asp Asp Asp Phe Tyr Ser  
 740 745 750  
 Lys Phe Ser Thr Gly Ser Val Ser Ile Pro Trp Gln Asn Glu Met Ile  
 755 760 765  
 Glu Thr Glu Cys Phe Lys Glu Leu Asn Val Phe Gly Pro Asn Gly Thr  
 770 775 780



Leu Pro Pro Asp Leu Asn Arg Asn His Pro Pro Glu Pro Pro Lys Lys  
 785 790 795 800  
 Gly Leu Leu Gln Arg Leu Phe Lys Arg Gln His Gln Asn Asn Ser Lys  
 805 810 815  
 Ser Ser Pro Ser Ser Lys Thr Ser Phe Asn His His Ile Asn Ser Asn  
 820 825 830  
 His Val Ser Ser Asn Ser Thr Gly Ser Ser  
 835 840

(2) INFORMATION FOR SEQ ID NO:44:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1902 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1899
- (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:44:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65 70 75 80	
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG	288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85 90 95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG	336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu	
100 105 110	
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC	384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly	
115 120 125	

ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GCT CGA GCC ATC ATG AGC AGA AGC AAG CGT GAC Gly Leu Arg Ser Arg Ala Arg Ala Ile Met Ser Arg Ser Lys Arg Asp 245 250 255	768
AAC AAT TTT TAT AGT GTA GAG ATT GGA GAT TCT ACA TTC ACA GTC CTG Asn Asn Phe Tyr Ser Val Glu Ile Gly Asp Ser Thr Phe Thr Val Leu 260 265 270	816
AAA CGA TAT CAG AAT TTA AAA CCT ATA GGC TCA GGA GCT CAA GGA ATA Lys Arg Tyr Gln Asn Leu Lys Pro Ile Gly Ser Gly Ala Gln Gly Ile 275 280 285	864
GTA TGC GCA GCT TAT GAT GCC ATT CTT GAA AGA AAT GTT GCA ATC AAG Val Cys Ala Ala Tyr Asp Ala Ile Leu Glu Arg Asn Val Ala Ile Lys 290 295 300	912
AAG CTA AGC CGA CCA TTT CAG AAT CAG ACT CAT GCC AAG CGG GCC TAC Lys Leu Ser Arg Pro Phe Gln Asn Gln Thr His Ala Lys Arg Ala Tyr 305 310 315 320	960
AGA GAG CTA GTT CTT ATG AAA TGT GTT AAT CAC AAA AAT ATA ATT GGC Arg Glu Leu Val Leu Met Lys Cys Val Asn His Lys Asn Ile Ile Gly 325 330 335	1008
CTT TTG AAT GTT TTC ACA CCA CAG AAA TCC CTA GAA GAA TTT CAA GAT Leu Leu Asn Val Phe Thr Pro Gln Lys Ser Leu Glu Glu Phe Gln Asp 340 345 350	1056
GTT TAC ATA GTC ATG GAG CTC ATG GAT GCA AAT CTT TGC CAA GTG ATT Val Tyr Ile Val Met Glu Leu Met Asp Ala Asn Leu Cys Gln Val Ile	1104

355	360	365	
CAG ATG GAG CTA GAT CAT GAA AGA ATG TCC TAC CTT CTC TAT CAG ATG Gln Met Glu Leu Asp His Glu Arg Met Ser Tyr Leu Leu Tyr Gln Met 370 375 380			1152
CTG TGT GGA ATC AAG CAC CTT CAT TCT GCT GGA ATT ATT CAT CGG GAC Leu Cys Gly Ile Lys His Leu His Ser Ala Gly Ile Ile His Arg Asp 385 390 395 400			1200
TTA AAG CCC AGT AAT ATA GTA GTA AAA TCT GAT TGC ACT TTG AAG ATT Leu Lys Pro Ser Asn Ile Val Val Lys Ser Asp Cys Thr Leu Lys Ile 405 410 415			1248
CTT GAC TTC GGT CTG GCC AGG ACT GCA GGA ACG AGT TTT ATG ATG ACG Leu Asp Phe Gly Leu Ala Arg Thr Ala Gly Thr Ser Phe Met Met Thr 420 425 430			1296
CCT TAT GTA GTG ACT CGC TAC TAC AGA GCA CCC GAG GTC ATC CTT GGC Pro Tyr Val Val Thr Arg Tyr Tyr Arg Ala Pro Glu Val Ile Leu Gly 435 440 445			1344
ATG GGC TAC AAG GAA AAC GTG GAT TTA TGG TCT GTG GGG TGC ATT ATG Met Gly Tyr Lys Glu Asn Val Asp Leu Trp Ser Val Gly Cys Ile Met 450 455 460			1392
GGA GAA ATG GTT TGC CAC AAA ATC CTC TTT CCA GGA AGG GAC TAT ATT Gly Glu Met Val Cys His Lys Ile Leu Phe Pro Gly Arg Asp Tyr Ile 465 470 475 480			1440
GAT CAG TGG AAT AAA GTT ATT GAA CAG CTT GGA ACA CCA TGT CCT GAA Asp Gln Trp Asn Lys Val Ile Glu Gln Leu Gly Thr Pro Cys Pro Glu 485 490 495			1488
TTC ATG AAG AAA CTG CAA CCA ACA GTA AGG ACT TAC GTT GAA AAC AGA Phe Met Lys Lys Leu Gln Pro Thr Val Arg Thr Tyr Val Glu Asn Arg 500 505 510			1536
CCT AAA TAT GCT GGA TAT AGC TTT GAG AAA CTC TTC CCT GAT GTC CTT Pro Lys Tyr Ala Gly Tyr Ser Phe Glu Lys Leu Phe Pro Asp Val Leu 515 520 525			1584
TTC CCA GCT GAC TCA GAA CAC AAC AAA CTT AAA GCC AGT CAG GCA AGG Phe Pro Ala Asp Ser Glu His Asn Lys Leu Lys Ala Ser Gln Ala Arg 530 535 540			1632
GAT TTG TTA TCC AAA ATG CTG GTA ATA GAT GCA TCT AAA AGG ATC TCT Asp Leu Leu Ser Lys Met Leu Val Ile Asp Ala Ser Lys Arg Ile Ser 545 550 555 560			1680
GTA GAT GAA GCT CTC CAA CAC CCG TAC ATC AAT GTC TGG TAT GAT CCT Val Asp Glu Ala Leu Gln His Pro Tyr Ile Asn Val Trp Tyr Asp Pro 565 570 575			1728
TCT GAA GCA GAA GCT CCA CCA CCA AAG ATC CCT GAC AAG CAG TTA GAT Ser Glu Ala Glu Ala Pro Pro Pro Lys Ile Pro Asp Lys Gln Leu Asp 580 585 590			1776

GAA	AGG	GAA	CAC	ACA	ATA	GAA	GAG	TGG	AAA	GAA	TTG	ATA	TAT	AAG	GAA
Glu	Arg	Glu	His	Thr	Ile	Glu	Glu	Trp	Lys	Glu	Leu	Ile	Tyr	Lys	Glu
595						600				605					
GTT	ATG	GAC	TTG	GAG	GAG	AGA	ACC	AAG	AAT	GGA	GTT	ATA	CGG	GGG	CAG
Val	Met	Asp	Leu	Glu	Glu	Arg	Thr	Lys	Asn	Gly	Val	Ile	Arg	Gly	Gln
610							615				620				
CCC	TCT	CCT	TTA	GCA	CAG	GTG	CAG	CAG	TGA						
Pro	Ser	Pro	Leu	Ala	Gln	Val	Gln	Gln							
625				630								1902			

(2) INFORMATION FOR SEO ID NO:45:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 633 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:45:

Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu
1				5					10					15	
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly
			20					25					30		
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile
			35				40					45			
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr
	50					55					60				
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys
65				70						75					80
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu
				85					90					95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu
			100					105					110		
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly
			115				120					125			
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr
	130					135					140				
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn
145				150						155					160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser
				165					170					175	
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly
			180					185					190		
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu
		195				200						205			
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe
	210					215					220				
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser
225				230						235					240
Gly	Leu	Arg	Ser	Arg	Ala	Arg	Ala	Ile	Met	Ser	Arg	Ser	Lys	Arg	Asp
				245					250					255	

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Asn Asn Phe Tyr Ser Val Glu Ile Gly Asp Ser Thr Phe Thr Val Leu
260                               265                               270
Lys Arg Tyr Gln Asn Leu Lys Pro Ile Gly Ser Gly Ala Gln Gly Ile
275                               280                               285
Val Cys Ala Ala Tyr Asp Ala Ile Leu Glu Arg Asn Val Ala Ile Lys
290                               295                               300
Lys Leu Ser Arg Pro Phe Gln Asn Gln Thr His Ala Lys Arg Ala Tyr
305                               310                               315                               320
Arg Glu Leu Val Leu Met Lys Cys Val Asn His Lys Asn Ile Ile Gly
325                               330                               335
Leu Leu Asn Val Phe Thr Pro Gln Lys Ser Leu Glu Glu Phe Gln Asp
340                               345                               350
Val Tyr Ile Val Met Glu Leu Met Asp Ala Asn Leu Cys Gln Val Ile
355                               360                               365
Gln Met Glu Leu Asp His Glu Arg Met Ser Tyr Leu Leu Tyr Gln Met
370                               375                               380
Leu Cys Gly Ile Lys His Leu His Ser Ala Gly Ile Ile His Arg Asp
385                               390                               395                               400
Leu Lys Pro Ser Asn Ile Val Val Lys Ser Asp Cys Thr Leu Lys Ile
405                               410                               415
Leu Asp Phe Gly Leu Ala Arg Thr Ala Gly Thr Ser Phe Met Met Thr
420                               425                               430
Pro Tyr Val Val Thr Arg Tyr Tyr Arg Ala Pro Glu Val Ile Leu Gly
435                               440                               445
Met Gly Tyr Lys Glu Asn Val Asp Leu Trp Ser Val Gly Cys Ile Met
450                               455                               460
Gly Glu Met Val Cys His Lys Ile Leu Phe Pro Gly Arg Asp Tyr Ile
465                               470                               475                               480
Asp Gln Trp Asn Lys Val Ile Glu Gln Leu Gly Thr Pro Cys Pro Glu
485                               490                               495
Phe Met Lys Lys Leu Gln Pro Thr Val Arg Thr Tyr Val Glu Asn Arg
500                               505                               510
Pro Lys Tyr Ala Gly Tyr Ser Phe Glu Lys Leu Phe Pro Asp Val Leu
515                               520                               525
Phe Pro Ala Asp Ser Glu His Asn Lys Leu Lys Ala Ser Gln Ala Arg
530                               535                               540
Asp Leu Leu Ser Lys Met Leu Val Ile Asp Ala Ser Lys Arg Ile Ser
545                               550                               555                               560
Val Asp Glu Ala Leu Gln His Pro Tyr Ile Asn Val Trp Tyr Asp Pro
565                               570                               575
Ser Glu Ala Glu Ala Pro Pro Pro Lys Ile Pro Asp Lys Gln Leu Asp
580                               585                               590
Glu Arg Glu His Thr Ile Glu Glu Trp Lys Glu Leu Ile Tyr Lys Glu
595                               600                               605
Val Met Asp Leu Glu Glu Arg Thr Lys Asn Gly Val Ile Arg Gly Gln
610                               615                               620
Pro Ser Pro Leu Ala Gln Val Gln Gln
625                               630

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## (2) INFORMATION FOR SEQ ID NO:46:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1824 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
 (B) LOCATION: 1...1821  
 (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:46:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65 70 75 80	
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG	288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85 90 95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG	336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu	
100 105 110	
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC	384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly	
115 120 125	
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC	432
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr	
130 135 140	
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC	480
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn	
145 150 155 160	
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC	528
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser	
165 170 175	
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC	576
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly	
180 185 190	
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG	624
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu	

195	200	205	
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220			672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240			720
GGA CTC AGA TCT CGA GGG AAA ATG TCT CAG GAG AGG CCC ACG TTC TAC Gly Leu Arg Ser Arg Gly Lys Met Ser Gln Glu Arg Pro Thr Phe Tyr 245 250 255			768
CGG CAG GAG CTG AAC AAG ACA ATC TGG GAG GTG CCC GAG CGT TAC CAG Arg Gln Glu Leu Asn Lys Thr Ile Trp Glu Val Pro Glu Arg Tyr Gln 260 265 270			816
AAC CTG TCT CCA GTG GGC TCT GGC GCC TAT GGC TCT GTG TGT GCT GCT Asn Leu Ser Pro Val Gly Ser Gly Ala Tyr Gly Ser Val Cys Ala Ala 275 280 285			864
TTT GAC ACA AAA ACG GGG TTA CGT GTG GCA GTG AAG AAG CTC TCC AGA Phe Asp Thr Lys Thr Gly Leu Arg Val Ala Val Lys Lys Leu Ser Arg 290 295 300			912
CCA TTT CAG TCC ATC ATT CAT GCG AAA AGA ACC TAC AGA GAA CTG CGG Pro Phe Gln Ser Ile Ile His Ala Lys Arg Thr Tyr Arg Glu Leu Arg 305 310 315 320			960
TTA CTT AAA CAT ATG AAA CAT GAA AAT GTG ATT GGT CTG TTG GAC GTT Leu Leu Lys His Met Lys His Glu Asn Val Ile Gly Leu Leu Asp Val 325 330 335			1008
TTT ACA CCT GCA AGG TCT CTG GAG GAA TTC AAT GAT GTG TAT CTG GTG Phe Thr Pro Ala Arg Ser Leu Glu Glu Phe Asn Asp Val Tyr Leu Val 340 345 350			1056
ACC CAT CTC ATG GGG GCA GAT CTG AAC AAC ATT GTG AAA TGT CAG AAG Thr His Leu Met Gly Ala Asp Leu Asn Asn Ile Val Lys Cys Gln Lys 355 360 365			1104
CTT ACA GAT GAC CAT GTT CAG TTC CTT ATC TAC CAA ATT CTC CGA GGT Leu Thr Asp Asp His Val Gln Phe Leu Ile Tyr Gln Ile Leu Arg Gly 370 375 380			1152
CTA AAG TAT ATA CAT TCA GCT GAC ATA ATT CAC AGG GAC CTA AAA CCT Leu Lys Tyr Ile His Ser Ala Asp Ile Ile His Arg Asp Leu Lys Pro 385 390 395 400			1200
AGT AAT CTA GCT GTG AAT GAA GAC TGT GAG CTG AAG ATT CTG GAT TTT Ser Asn Leu Ala Val Asn Glu Asp Cys Glu Leu Lys Ile Leu Asp Phe 405 410 415			1248
GGA CTG GCT CGG CAC ACA GAT GAT GAA ATG ACA GGC TAC GTG GCC ACT Gly Leu Ala Arg His Thr Asp Asp Glu Met Thr Gly Tyr Val Ala Thr 420 425 430			1296

AGG TGG TAC AGG GCT CCT GAG ATC ATG CTG AAC TGG ATG CAT TAC AAC Arg Trp Tyr Arg Ala Pro Glu Ile Met Leu Asn Trp Met His Tyr Asn 435 440 445	1344
CAG ACA GTT GAT ATT TGG TCA GTG GGA TGC ATA ATG GCC GAG CTG TTG Gln Thr Val Asp Ile Trp Ser Val Gly Cys Ile Met Ala Glu Leu Leu 450 455 460	1392
ACT GGA AGA ACA TTG TTT CCT GGT ACA GAC CAT ATT GAT CAG TTG AAG Thr Gly Arg Thr Leu Phe Pro Gly Thr Asp His Ile Asp Gln Leu Lys 465 470 475 480	1440
CTC ATT TTA AGA CTC GTT GGA ACC CCA GGG GCT GAG CTT TTG AAG AAA Leu Ile Leu Arg Leu Val Gly Thr Pro Gly Ala Glu Leu Leu Lys Lys 485 490 495	1488
ATC TCC TCA GAG TCT GCA AGA AAC TAT ATT CAG TCT TTG ACT CAG ATG Ile Ser Ser Glu Ser Ala Arg Asn Tyr Ile Gln Ser Leu Thr Gln Met 500 505 510	1536
CCG AAG ATG AAC TTT GCG AAT GTA TTT ATT GGT GCC AAT CCC CTG GCT Pro Lys Met Asn Phe Ala Asn Val Phe Ile Gly Ala Asn Pro Leu Ala 515 520 525	1584
GTC GAC TTG CTG GAG AAG ATG CTT GTA TTG GAC TCA GAT AAG AGA ATT Val Asp Leu Leu Glu Lys Met Leu Val Leu Asp Ser Asp Lys Arg Ile 530 535 540	1632
ACA GCG GCC CAA GCC CTT GCA CAT GCC TAC TTT GCT CAG TAC CAC GAT Thr Ala Ala Gln Ala Leu Ala His Ala Tyr Phe Ala Gln Tyr His Asp 545 550 555 560	1680
CCT GAT GAT GAA CCA GTG GCC GAT CCT TAT GAT CAG TCC TTT GAA AGC Pro Asp Asp Glu Pro Val Ala Asp Pro Tyr Asp Gln Ser Phe Glu Ser 565 570 575	1728
AGG GAC CTC CTT ATA GAT GAG TGG AAA AGC CTG ACC TAT GAT GAA GTC Arg Asp Leu Leu Ile Asp Glu Trp Lys Ser Leu Thr Tyr Asp Glu Val 580 585 590	1776
ATC AGC TTT GTG CCA CCA CCC CTT GAC CAA GAA GAG ATG GAG TCC TGA Ile Ser Phe Val Pro Pro Pro Leu Asp Gln Glu Glu Met Glu Ser 595 600 605	1824

## (2) INFORMATION FOR SEQ ID NO:47:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 607 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:47:



Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu
1				5					10					15	
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly
			20					25					30		
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile
		35					40					45			
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr
	50					55				60					
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys
65				70						75					80
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu
			85						90					95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu
			100					105						110	
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly
		115					120					125			
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr
	130					135					140				
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn
145				150						155					160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser
			165						170					175	
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly
		180						185					190		
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu
	195					200						205			
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe
	210					215				220					
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser
225				230						235					240
Gly	Leu	Arg	Ser	Arg	Gly	Lys	Met	Ser	Gln	Glu	Arg	Pro	Thr	Phe	Tyr
			245						250					255	
Arg	Gln	Glu	Leu	Asn	Lys	Thr	Ile	Trp	Glu	Val	Pro	Glu	Arg	Tyr	Gln
		260						265					270		
Asn	Leu	Ser	Pro	Val	Gly	Ser	Gly	Ala	Tyr	Gly	Ser	Val	Cys	Ala	Ala
	275					280						285			
Phe	Asp	Thr	Lys	Thr	Gly	Leu	Arg	Val	Ala	Val	Lys	Lys	Leu	Ser	Arg
	290					295					300				
Pro	Phe	Gln	Ser	Ile	Ile	His	Ala	Lys	Arg	Thr	Tyr	Arg	Glu	Leu	Arg
305				310						315					320
Leu	Leu	Lys	His	Met	Lys	His	Glu	Asn	Val	Ile	Gly	Leu	Leu	Asp	Val
			325						330					335	
Phe	Thr	Pro	Ala	Arg	Ser	Leu	Glu	Glu	Phe	Asn	Asp	Val	Tyr	Leu	Val
		340						345					350		
Thr	His	Leu	Met	Gly	Ala	Asp	Leu	Asn	Asn	Ile	Val	Lys	Cys	Gln	Lys
		355					360					365			
Leu	Thr	Asp	Asp	His	Val	Gln	Phe	Leu	Ile	Tyr	Gln	Ile	Leu	Arg	Gly
	370					375					380				
Leu	Lys	Tyr	Ile	His	Ser	Ala	Asp	Ile	Ile	His	Arg	Asp	Leu	Lys	Pro
385				390						395					400
Ser	Asn	Leu	Ala	Val	Asn	Glu	Asp	Cys	Glu	Leu	Lys	Ile	Leu	Asp	Phe
			405						410					415	
Gly	Leu	Ala	Arg	His	Thr	Asp	Asp	Glu	Met	Thr	Gly	Tyr	Val	Ala	Thr
		420						425					430		
Arg	Trp	Tyr	Arg	Ala	Pro	Glu	Ile	Met	Leu	Asn	Trp	Met	His	Tyr	Asn
	435						440					445			
Gln	Thr	Val	Asp	Ile	Trp	Ser	Val	Gly	Cys	Ile	Met	Ala	Glu	Leu	Leu
	450					455					460				

```

Thr Gly Arg Thr Leu Phe Pro Gly Thr Asp His Ile Asp Gln Leu Lys
465                               470                               475                               480
Leu Ile Leu Arg Leu Val Gly Thr Pro Gly Ala Glu Leu Leu Lys Lys
                               485                               490                               495
Ile Ser Ser Glu Ser Ala Arg Asn Tyr Ile Gln Ser Leu Thr Gln Met
                               500                               505                               510
Pro Lys Met Asn Phe Ala Asn Val Phe Ile Gly Ala Asn Pro Leu Ala
                               515                               520                               525
Val Asp Leu Leu Glu Lys Met Leu Val Leu Asp Ser Asp Lys Arg Ile
                               530                               535                               540
Thr Ala Ala Gln Ala Leu Ala His Ala Tyr Phe Ala Gln Tyr His Asp
545                               550                               555                               560
Pro Asp Asp Glu Pro Val Ala Asp Pro Tyr Asp Gln Ser Phe Glu Ser
                               565                               570                               575
Arg Asp Leu Leu Ile Asp Glu Trp Lys Ser Leu Thr Tyr Asp Glu Val
                               580                               585                               590
Ile Ser Phe Val Pro Pro Pro Leu Asp Gln Glu Glu Met Glu Ser
                               595                               600                               605

```

## (2) INFORMATION FOR SEQ ID NO:48:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2907 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2904
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:48:

```

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG      48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
1                               5                               10                               15

GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC      96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
                               20                               25                               30

GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC     144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
                               35                               40                               45

TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC     192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
                               50                               55                               60

CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG     240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
65                               70                               75                               80

CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG     288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu

```

85	90	95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu 100 105 110			336
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125			384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140			432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160			480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175			528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190			576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205			624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220			672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240			720
GGA CTC AGA TCT ATG AGT GCT GAG GGG TAC CAG TAC AGA GCG CTG TAT Gly Leu Arg Ser Met Ser Ala Glu Gly Tyr Gln Tyr Arg Ala Leu Tyr 245 250 255			768
GAT TAT AAA AAG GAA AGA GAA GAA GAT ATT GAC TTG CAC TTG GGT GAC Asp Tyr Lys Lys Glu Arg Glu Glu Asp Ile Asp Leu His Leu Gly Asp 260 265 270			816
ATA TTG ACT GTG AAT AAA GGG TCC TTA GTA GCT CTT GGA TTC AGT GAT Ile Leu Thr Val Asn Lys Gly Ser Leu Val Ala Leu Gly Phe Ser Asp 275 280 285			864
GGA CAG GAA GCC AGG CCT GAA GAA ATT GGC TGG TTA AAT GGC TAT AAT Gly Gln Glu Ala Arg Pro Glu Glu Ile Gly Trp Leu Asn Gly Tyr Asn 290 295 300			912
GAA ACC ACA GGG GAA AGG GGG GAC TTT CCG GGA ACT TAC GTA GAA TAT Glu Thr Thr Gly Glu Arg Gly Asp Phe Pro Gly Thr Tyr Val Glu Tyr 305 310 315 320			960

ATT GGA AGG AAA AAA ATC TCG CCT CCC ACA CCA AAG CCC CGG CCA CCT	1008
Ile Gly Arg Lys Lys Ile Ser Pro Pro Thr Pro Lys Pro Arg Pro Pro	
325 330 335	
CGG CCT CTT CCT GTT GCA CCA GGT TCT TCG AAA ACT GAA GCA GAT GTT	1056
Arg Pro Leu Pro Val Ala Pro Gly Ser Ser Lys Thr Glu Ala Asp Val	
340 345 350	
GAA CAA CAA GCT TTG ACT CTC CCG GAT CTT GCA GAG CAG TTT GCC CCT	1104
Glu Gln Gln Ala Leu Thr Leu Pro Asp Leu Ala Glu Gln Phe Ala Pro	
355 360 365	
CCT GAC ATT GCC CCG CCT CTT CTT ATC AAG CTC GTG GAA GCC ATT GAA	1152
Pro Asp Ile Ala Pro Pro Leu Leu Ile Lys Leu Val Glu Ala Ile Glu	
370 375 380	
AAG AAA GGT CTG GAA TGT TCA ACT CTA TAC AGA ACA CAG AGC TCC AGC	1200
Lys Lys Gly Leu Glu Cys Ser Thr Leu Tyr Arg Thr Gln Ser Ser Ser	
385 390 395 400	
AAC CTG GCA GAA TTA CGA CAG CTT CTT GAT TGT GAT ACA CCC TCC GTG	1248
Asn Leu Ala Glu Leu Arg Gln Leu Leu Asp Cys Asp Thr Pro Ser Val	
405 410 415	
GAC TTG GAA ATG ATC GAT GTG CAC GTT TTG GCT GAC GCT TTC AAA CGC	1296
Asp Leu Glu Met Ile Asp Val His Val Leu Ala Asp Ala Phe Lys Arg	
420 425 430	
TAT CTC CTG GAC TTA CCA AAT CCT GTC ATT CCA GCA GCC GTT TAC AGT	1344
Tyr Leu Leu Asp Leu Pro Asn Pro Val Ile Pro Ala Ala Val Tyr Ser	
435 440 445	
GAA ATG ATT TCT TTA GCT CCA GAA GTA CAA AGC TCC GAA GAA TAT ATT	1392
Glu Met Ile Ser Leu Ala Pro Glu Val Gln Ser Ser Glu Glu Tyr Ile	
450 455 460	
CAG CTA TTG AAG AAG CTT ATT AGG TCG CCT AGC ATA CCT CAT CAG TAT	1440
Gln Leu Leu Lys Lys Leu Ile Arg Ser Pro Ser Ile Pro His Gln Tyr	
465 470 475 480	
TGG CTT ACG CTT CAG TAT TTG TTA AAA CAT TTC TTC AAG CTC TCT CAA	1488
Trp Leu Thr Leu Gln Tyr Leu Leu Lys His Phe Phe Lys Leu Ser Gln	
485 490 495	
ACC TCC AGC AAA AAT CTG TTG AAT GCA AGA GTA CTC TCT GAA ATT TTC	1536
Thr Ser Ser Lys Asn Leu Leu Asn Ala Arg Val Leu Ser Glu Ile Phe	
500 505 510	
AGC CCT ATG CTT TTC AGA TTC TCA GCA GCC AGC TCT GAT AAT ACT GAA	1584
Ser Pro Met Leu Phe Arg Phe Ser Ala Ala Ser Ser Asp Asn Thr Glu	
515 520 525	
AAC CTC ATA AAA GTT ATA GAA ATT TTA ATC TCA ACT GAA TGG AAT GAA	1632
Asn Leu Ile Lys Val Ile Glu Ile Leu Ile Ser Thr Glu Trp Asn Glu	
530 535 540	
CGA CAG CCT GCA CCA GCA CTG CCT CCT AAA CCA CCA AAA CCT ACT ACT	1680
Arg Gln Pro Ala Pro Ala Leu Pro Pro Lys Pro Pro Lys Pro Thr Thr	

545	550	555	560	
GTA GCC AAC AAC GGT ATG AAT AAC AAT ATG TCC TTA CAA AAT GCT GAA				1728
Val Ala Asn Asn Gly Met Asn Asn Asn Met Ser Leu Gln Asn Ala Glu				
565		570	575	
TGG TAC TGG GGA GAT ATC TCG AGG GAA GAA GTG AAT GAA AAA CTT CGA				1776
Trp Tyr Trp Gly Asp Ile Ser Arg Glu Glu Val Asn Glu Lys Leu Arg				
580		585	590	
GAT ACA GCA GAC GGG ACC TTT TTG GTA CGA GAT GCG TCT ACT AAA ATG				1824
Asp Thr Ala Asp Gly Thr Phe Leu Val Arg Asp Ala Ser Thr Lys Met				
595	600		605	
CAT GGT GAT TAT ACT CTT ACA CTA AGG AAA GGG GGA AAT AAC AAA TTA				1872
His Gly Asp Tyr Thr Leu Thr Leu Arg Lys Gly Gly Asn Asn Lys Leu				
610	615		620	
ATC AAA ATA TTT CAT CGA GAT GGG AAA TAT GGC TTC TCT GAC CCA TTA				1920
Ile Lys Ile Phe His Arg Asp Gly Lys Tyr Gly Phe Ser Asp Pro Leu				
625	630		635	640
ACC TTC AGT TCT GTG GTT GAA TTA ATA AAC CAC TAC CGG AAT GAA TCT				1968
Thr Phe Ser Ser Val Val Glu Leu Ile Asn His Tyr Arg Asn Glu Ser				
645		650	655	
CTA GCT CAG TAT AAT CCC AAA TTG GAT GTG AAA TTA CTT TAT CCA GTA				2016
Leu Ala Gln Tyr Asn Pro Lys Leu Asp Val Lys Leu Leu Tyr Pro Val				
660		665	670	
TCC AAA TAC CAA CAG GAT CAA GTT GTC AAA GAA GAT AAT ATT GAA GCT				2064
Ser Lys Tyr Gln Gln Asp Gln Val Val Lys Glu Asp Asn Ile Glu Ala				
675		680	685	
GTA GGG AAA AAA TTA CAT GAA TAT AAC ACT CAG TTT CAA GAA AAA AGT				2112
Val Gly Lys Lys Leu His Glu Tyr Asn Thr Gln Phe Gln Glu Lys Ser				
690	695		700	
CGA GAA TAT GAT AGA TTA TAT GAA GAA TAT ACC CGC ACA TCC CAG GAA				2160
Arg Glu Tyr Asp Arg Leu Tyr Glu Glu Tyr Thr Arg Thr Ser Gln Glu				
705	710		715	720
ATC CAA ATG AAA AGG ACA GCT ATT GAA GCA TTT AAT GAA ACC ATA AAA				2208
Ile Gln Met Lys Arg Thr Ala Ile Glu Ala Phe Asn Glu Thr Ile Lys				
725		730	735	
ATA TTT GAA GAA CAG TGC CAG ACC CAA GAG CGG TAC AGC AAA GAA TAC				2256
Ile Phe Glu Glu Gln Cys Gln Thr Gln Glu Arg Tyr Ser Lys Glu Tyr				
740		745	750	
ATA GAA AAG TTT AAA CGT GAA GGC AAT GAG AAA GAA ATA CAA AGG ATT				2304
Ile Glu Lys Phe Lys Arg Glu Gly Asn Glu Lys Glu Ile Gln Arg Ile				
755	760		765	
ATG CAT AAT TAT GAT AAG TTG AAG TCT CGA ATC AGT GAA ATT ATT GAC				2352
Met His Asn Tyr Asp Lys Leu Lys Ser Arg Ile Ser Glu Ile Ile Asp				
770	775		780	

[illegible]

(2) INFORMATION FOR SEQ ID NO:49:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 968 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:49:

```

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
 1           5           10           15
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
      20           25           30
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
      35           40           45
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
      50           55           60
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
      65           70           75           80
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu
      85           90           95
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu
      100          105          110
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly
      115          120          125
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr
      130          135          140
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn
      145          150          155          160
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser
      165          170          175
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly
      180          185          190
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu
      195          200          205
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe
      210          215          220
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser
      225          230          235          240
Gly Leu Arg Ser Met Ser Ala Glu Gly Tyr Gln Tyr Arg Ala Leu Tyr
      245          250          255
Asp Tyr Lys Lys Glu Arg Glu Glu Asp Ile Asp Leu His Leu Gly Asp
      260          265          270
Ile Leu Thr Val Asn Lys Gly Ser Leu Val Ala Leu Gly Phe Ser Asp
      275          280          285
Gly Gln Glu Ala Arg Pro Glu Glu Ile Gly Trp Leu Asn Gly Tyr Asn
      290          295          300
Glu Thr Thr Gly Glu Arg Gly Asp Phe Pro Gly Thr Tyr Val Glu Tyr
      305          310          315          320
Ile Gly Arg Lys Lys Ile Ser Pro Pro Thr Pro Lys Pro Arg Pro Pro
      325          330          335
Arg Pro Leu Pro Val Ala Pro Gly Ser Ser Lys Thr Glu Ala Asp Val
      340          345          350
Glu Gln Gln Ala Leu Thr Leu Pro Asp Leu Ala Glu Gln Phe Ala Pro
      355          360          365
Pro Asp Ile Ala Pro Pro Leu Leu Ile Lys Leu Val Glu Ala Ile Glu
      370          375          380
Lys Lys Gly Leu Glu Cys Ser Thr Leu Tyr Arg Thr Gln Ser Ser Ser
      385          390          395          400
Asn Leu Ala Glu Leu Arg Gln Leu Leu Asp Cys Asp Thr Pro Ser Val
      405          410          415
Asp Leu Glu Met Ile Asp Val His Val Leu Ala Asp Ala Phe Lys Arg
      420          425          430

```

Tyr Leu Leu Asp Leu Pro Asn Pro Val Ile Pro Ala Ala Val Tyr Ser  
 435 440 445  
 Glu Met Ile Ser Leu Ala Pro Glu Val Gln Ser Ser Glu Glu Tyr Ile  
 450 455 460  
 Gln Leu Leu Lys Lys Leu Ile Arg Ser Pro Ser Ile Pro His Gln Tyr  
 465 470 475 480  
 Trp Leu Thr Leu Gln Tyr Leu Leu Lys His Phe Phe Lys Leu Ser Gln  
 485 490 495  
 Thr Ser Ser Lys Asn Leu Leu Asn Ala Arg Val Leu Ser Glu Ile Phe  
 500 505 510  
 Ser Pro Met Leu Phe Arg Phe Ser Ala Ala Ser Ser Asp Asn Thr Glu  
 515 520 525  
 Asn Leu Ile Lys Val Ile Glu Ile Leu Ile Ser Thr Glu Trp Asn Glu  
 530 535 540  
 Arg Gln Pro Ala Pro Ala Leu Pro Pro Lys Pro Pro Lys Pro Thr Thr  
 545 550 555 560  
 Val Ala Asn Asn Gly Met Asn Asn Asn Met Ser Leu Gln Asn Ala Glu  
 565 570 575  
 Trp Tyr Trp Gly Asp Ile Ser Arg Glu Glu Val Asn Glu Lys Leu Arg  
 580 585 590  
 Asp Thr Ala Asp Gly Thr Phe Leu Val Arg Asp Ala Ser Thr Lys Met  
 595 600 605  
 His Gly Asp Tyr Thr Leu Thr Leu Arg Lys Gly Gly Asn Asn Lys Leu  
 610 615 620  
 Ile Lys Ile Phe His Arg Asp Gly Lys Tyr Gly Phe Ser Asp Pro Leu  
 625 630 635 640  
 Thr Phe Ser Ser Val Val Glu Leu Ile Asn His Tyr Arg Asn Glu Ser  
 645 650 655  
 Leu Ala Gln Tyr Asn Pro Lys Leu Asp Val Lys Leu Leu Tyr Pro Val  
 660 665 670  
 Ser Lys Tyr Gln Gln Asp Gln Val Val Lys Glu Asp Asn Ile Glu Ala  
 675 680 685  
 Val Gly Lys Lys Leu His Glu Tyr Asn Thr Gln Phe Gln Glu Lys Ser  
 690 695 700  
 Arg Glu Tyr Asp Arg Leu Tyr Glu Glu Tyr Thr Arg Thr Ser Gln Glu  
 705 710 715 720  
 Ile Gln Met Lys Arg Thr Ala Ile Glu Ala Phe Asn Glu Thr Ile Lys  
 725 730 735  
 Ile Phe Glu Glu Gln Cys Gln Thr Gln Glu Arg Tyr Ser Lys Glu Tyr  
 740 745 750  
 Ile Glu Lys Phe Lys Arg Glu Gly Asn Glu Lys Glu Ile Gln Arg Ile  
 755 760 765  
 Met His Asn Tyr Asp Lys Leu Lys Ser Arg Ile Ser Glu Ile Ile Asp  
 770 775 780  
 Ser Arg Arg Arg Leu Glu Glu Asp Leu Lys Lys Gln Ala Ala Glu Tyr  
 785 790 795 800  
 Arg Glu Ile Asp Lys Arg Met Asn Ser Ile Lys Pro Asp Leu Ile Gln  
 805 810 815  
 Leu Arg Lys Thr Arg Asp Gln Tyr Leu Met Trp Leu Thr Gln Lys Gly  
 820 825 830  
 Val Arg Gln Lys Lys Leu Asn Glu Trp Leu Gly Asn Glu Asn Thr Glu  
 835 840 845  
 Asp Gln Tyr Ser Leu Val Glu Asp Asp Glu Asp Leu Pro His His Asp  
 850 855 860  
 Glu Lys Thr Trp Asn Val Gly Ser Ser Asn Arg Asn Lys Ala Glu Asn  
 865 870 875 880  
 Leu Leu Arg Gly Lys Arg Asp Gly Thr Phe Leu Val Arg Glu Ser Ser  
 885 890 895



Lys Gln Gly Cys Tyr Ala Cys Ser Val Val Val Asp Gly Glu Val Lys  
                   900                  905                  910  
 His Cys Val Ile Asn Lys Thr Ala Thr Gly Tyr Gly Phe Ala Glu Pro  
                   915                  920                  925  
 Tyr Asn Leu Tyr Ser Ser Leu Lys Glu Leu Val Leu His Tyr Gln His  
                   930                  935                  940  
 Thr Ser Leu Val Gln His Asn Asp Ser Leu Asn Val Thr Leu Ala Tyr  
                   945                  950                  955                  960  
 Pro Val Tyr Ala Gln Gln Arg Arg  
                                   965

(2) INFORMATION FOR SEQ ID NO:50:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2160 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2157
- (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:50:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1                  5                  10                  15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20                  25                  30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35                  40                  45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50                  55                  60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65                  70                  75                  80	
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG	288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85                  90                  95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG	336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu	
100                  105                  110	
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC	384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly	

115	120	125	
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC			432
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr			
130	135	140	
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC			480
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn			
145	150	155	160
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC			528
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser			
165	170	175	
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC			576
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly			
180	185	190	
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG			624
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu			
195	200	205	
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC			672
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe			
210	215	220	
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC			720
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser			
225	230	235	240
GGA CTC AGA TCT CGA GCT CAA GCT TCG AAT TCG ACC ATG TCG TCC ATC			768
Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Thr Met Ser Ser Ile			
245	250	255	
TTG CCA TTC ACG CCG CCA GTT GTG AAG AGA CTG CTG GGA TGG AAG AAG			816
Leu Pro Phe Thr Pro Pro Val Val Lys Arg Leu Leu Gly Trp Lys Lys			
260	265	270	
TCA GCT GGT GGG TCT GGA GGA GCA GGC GGA GGA GAG CAG AAT GGG CAG			864
Ser Ala Gly Gly Ser Gly Gly Ala Gly Gly Gly Glu Gln Asn Gly Gln			
275	280	285	
GAA GAA AAG TGG TGT GAG AAA GCA GTG AAA AGT CTG GTG AAG AAG CTA			912
Glu Glu Lys Trp Cys Glu Lys Ala Val Lys Ser Leu Val Lys Lys Leu			
290	295	300	
AAG AAA ACA GGA CGA TTA GAT GAG CTT GAG AAA GCC ATC ACC ACT CAA			960
Lys Lys Thr Gly Arg Leu Asp Glu Leu Glu Lys Ala Ile Thr Thr Gln			
305	310	315	320
AAC TGT AAT ACT AAA TGT GTT ACC ATA CCA AGC ACT TGC TCT GAA ATT			1008
Asn Cys Asn Thr Lys Cys Val Thr Ile Pro Ser Thr Cys Ser Glu Ile			
325	330	335	
TGG GGA CTG AGT ACA CCA AAT ACG ATA GAT CAG TGG GAT ACA ACA GGC			1056
Trp Gly Leu Ser Thr Pro Asn Thr Ile Asp Gln Trp Asp Thr Thr Gly			
340	345	350	

CTT TAC AGC TTC TCT GAA CAA ACC AGG TCT CTT GAT GGT CGT CTC CAG	1104
Leu Tyr Ser Phe Ser Glu Gln Thr Arg Ser Leu Asp Gly Arg Leu Gln	
355 360 365	
GTA TCC CAT CGA AAA GGA TTG CCA CAT GTT ATA TAT TGC CGA TTA TGG	1152
Val Ser His Arg Lys Gly Leu Pro His Val Ile Tyr Cys Arg Leu Trp	
370 375 380	
CGC TGG CCT GAT CTT CAC AGT CAT CAT GAA CTC AAG GCA ATT GAA AAC	1200
Arg Trp Pro Asp Leu His Ser His His Glu Leu Lys Ala Ile Glu Asn	
385 390 395 400	
TGC GAA TAT GCT TTT AAT CTT AAA AAG GAT GAA GTA TGT GTA AAC CCT	1248
Cys Glu Tyr Ala Phe Asn Leu Lys Lys Asp Glu Val Cys Val Asn Pro	
405 410 415	
TAC CAC TAT CAG AGA GTT GAG ACA CCA GTT TTG CCT CCA GTA TTA GTG	1296
Tyr His Tyr Gln Arg Val Glu Thr Pro Val Leu Pro Pro Val Leu Val	
420 425 430	
CCC CGA CAC ACC GAG ATC CTA ACA GAA CTT CCG CCT CTG GAT GAC TAT	1344
Pro Arg His Thr Glu Ile Leu Thr Glu Leu Pro Pro Leu Asp Asp Tyr	
435 440 445	
ACT CAC TCC ATT CCA GAA AAC ACT AAC TTC CCA GCA GGA ATT GAG CCA	1392
Thr His Ser Ile Pro Glu Asn Thr Asn Phe Pro Ala Gly Ile Glu Pro	
450 455 460	
CAG AGT AAT TAT ATT CCA GAA ACG CCA CCT CCT GGA TAT ATC AGT GAA	1440
Gln Ser Asn Tyr Ile Pro Glu Thr Pro Pro Pro Gly Tyr Ile Ser Glu	
465 470 475 480	
GAT GGA GAA ACA AGT GAC CAA CAG TTG AAT CAA AGT ATG GAC ACA GGC	1488
Asp Gly Glu Thr Ser Asp Gln Gln Leu Asn Gln Ser Met Asp Thr Gly	
485 490 495	
TCT CCA GCA GAA CTA TCT CCT ACT ACT CTT TCC CCT GTT AAT CAT AGC	1536
Ser Pro Ala Glu Leu Ser Pro Thr Thr Leu Ser Pro Val Asn His Ser	
500 505 510	
TTG GAT TTA CAG CCA GTT ACT TAC TCA GAA CCT GCA TTT TGG TGT TCA	1584
Leu Asp Leu Gln Pro Val Thr Tyr Ser Glu Pro Ala Phe Trp Cys Ser	
515 520 525	
ATA GCA TAT TAT GAA TTA AAT CAG AGG GTT GGA GAA ACC TTC CAT GCA	1632
Ile Ala Tyr Tyr Glu Leu Asn Gln Arg Val Gly Glu Thr Phe His Ala	
530 535 540	
TCA CAG CCC TCA CTC ACT GTA GAT GGC TTT ACA GAC CCA TCA AAT TCA	1680
Ser Gln Pro Ser Leu Thr Val Asp Gly Phe Thr Asp Pro Ser Asn Ser	
545 550 555 560	
GAG AGG TTC TGC TTA GGT TTA CTC TCC AAT GTT AAC CGA AAT GCC ACG	1728
Glu Arg Phe Cys Leu Gly Leu Leu Ser Asn Val Asn Arg Asn Ala Thr	
565 570 575	
GTA GAA ATG ACA AGA AGG CAT ATA GGA AGA GGA GTG CGC TTA TAC TAC	1776
Val Glu Met Thr Arg Arg His Ile Gly Arg Gly Val Arg Leu Tyr Tyr	

580	585	590	
ATA GGT GGG GAA GTT TTT GCT GAG TGC CTA AGT GAT AGT GCA ATC TTT			1824
Ile Gly Gly Glu Val Phe Ala Glu Cys Leu Ser Asp Ser Ala Ile Phe			
595	600	605	
GTG CAG AGC CCC AAT TGT AAT CAG AGA TAT GGC TGG CAC CCT GCA ACA			1872
Val Gln Ser Pro Asn Cys Asn Gln Arg Tyr Gly Trp His Pro Ala Thr			
610	615	620	
GTG TGT AAA ATT CCA CCA GGC TGT AAT CTG AAG ATC TTC AAC AAC CAG			1920
Val Cys Lys Ile Pro Pro Gly Cys Asn Leu Lys Ile Phe Asn Asn Gln			
625	630	635	640
GAA TTT GCT GCT CTT CTG GCT CAG TCT GTT AAT CAG GGT TTT GAA GCC			1968
Glu Phe Ala Ala Leu Leu Ala Gln Ser Val Asn Gln Gly Phe Glu Ala			
645	650	655	
GTC TAT CAG CTA ACT AGA ATG TGC ACC ATA AGA ATG AGT TTT GTG AAA			2016
Val Tyr Gln Leu Thr Arg Met Cys Thr Ile Arg Met Ser Phe Val Lys			
660	665	670	
GGG TGG GGA GCA GAA TAC CGA AGG CAG ACG GTA ACA AGT ACT CCT TGC			2064
Gly Trp Gly Ala Glu Tyr Arg Arg Gln Thr Val Thr Ser Thr Pro Cys			
675	680	685	
TGG ATT GAA CTT CAT CTG AAT GGA CCT CTA CAG TGG TTG GAC AAA GTA			2112
Trp Ile Glu Leu His Leu Asn Gly Pro Leu Gln Trp Leu Asp Lys Val			
690	695	700	
TTA ACT CAG ATG GGA TCC CCT TCA GTG CGT TGC TCA AGC ATG TCA TAA			2160
Leu Thr Gln Met Gly Ser Pro Ser Val Arg Cys Ser Ser Met Ser			
705	710	715	

## (2) INFORMATION FOR SEQ ID NO:51:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 719 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:51:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu			
1	5	10	15
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly			
20	25	30	
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile			
35	40	45	
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr			
50	55	60	
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys			
65	70	75	80

Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu  
 85 90 95  
 Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu  
 100 105 110  
 Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly  
 115 120 125  
 Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr  
 130 135 140  
 Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn  
 145 150 155 160  
 Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser  
 165 170 175  
 Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly  
 180 185 190  
 Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu  
 195 200 205  
 Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe  
 210 215 220  
 Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser  
 225 230 235 240  
 Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Thr Met Ser Ser Ile  
 245 250 255  
 Leu Pro Phe Thr Pro Pro Val Val Lys Arg Leu Leu Gly Trp Lys Lys  
 260 265 270  
 Ser Ala Gly Gly Ser Gly Gly Ala Gly Gly Gly Glu Gln Asn Gly Gln  
 275 280 285  
 Glu Glu Lys Trp Cys Glu Lys Ala Val Lys Ser Leu Val Lys Lys Leu  
 290 295 300  
 Lys Lys Thr Gly Arg Leu Asp Glu Leu Glu Lys Ala Ile Thr Thr Gln  
 305 310 315 320  
 Asn Cys Asn Thr Lys Cys Val Thr Ile Pro Ser Thr Cys Ser Glu Ile  
 325 330 335  
 Trp Gly Leu Ser Thr Pro Asn Thr Ile Asp Gln Trp Asp Thr Thr Gly  
 340 345 350  
 Leu Tyr Ser Phe Ser Glu Gln Thr Arg Ser Leu Asp Gly Arg Leu Gln  
 355 360 365  
 Val Ser His Arg Lys Gly Leu Pro His Val Ile Tyr Cys Arg Leu Trp  
 370 375 380  
 Arg Trp Pro Asp Leu His Ser His His Glu Leu Lys Ala Ile Glu Asn  
 385 390 395 400  
 Cys Glu Tyr Ala Phe Asn Leu Lys Lys Asp Glu Val Cys Val Asn Pro  
 405 410 415  
 Tyr His Tyr Gln Arg Val Glu Thr Pro Val Leu Pro Pro Val Leu Val  
 420 425 430  
 Pro Arg His Thr Glu Ile Leu Thr Glu Leu Pro Pro Leu Asp Asp Tyr  
 435 440 445  
 Thr His Ser Ile Pro Glu Asn Thr Asn Phe Pro Ala Gly Ile Glu Pro  
 450 455 460  
 Gln Ser Asn Tyr Ile Pro Glu Thr Pro Pro Pro Gly Tyr Ile Ser Glu  
 465 470 475 480  
 Asp Gly Glu Thr Ser Asp Gln Gln Leu Asn Gln Ser Met Asp Thr Gly  
 485 490 495  
 Ser Pro Ala Glu Leu Ser Pro Thr Thr Leu Ser Pro Val Asn His Ser  
 500 505 510  
 Leu Asp Leu Gln Pro Val Thr Tyr Ser Glu Pro Ala Phe Trp Cys Ser  
 515 520 525  
 Ile Ala Tyr Tyr Glu Leu Asn Gln Arg Val Gly Glu Thr Phe His Ala  
 530 535 540

Ser Gln Pro Ser Leu Thr Val Asp Gly Phe Thr Asp Pro Ser Asn Ser  
 545 550 555 560  
 Glu Arg Phe Cys Leu Gly Leu Leu Ser Asn Val Asn Arg Asn Ala Thr  
 565 570 575  
 Val Glu Met Thr Arg Arg His Ile Gly Arg Gly Val Arg Leu Tyr Tyr  
 580 585 590  
 Ile Gly Gly Glu Val Phe Ala Glu Cys Leu Ser Asp Ser Ala Ile Phe  
 595 600 605  
 Val Gln Ser Pro Asn Cys Asn Gln Arg Tyr Gly Trp His Pro Ala Thr  
 610 615 620  
 Val Cys Lys Ile Pro Pro Gly Cys Asn Leu Lys Ile Phe Asn Asn Gln  
 625 630 635 640  
 Glu Phe Ala Ala Leu Leu Ala Gln Ser Val Asn Gln Gly Phe Glu Ala  
 645 650 655  
 Val Tyr Gln Leu Thr Arg Met Cys Thr Ile Arg Met Ser Phe Val Lys  
 660 665 670  
 Gly Trp Gly Ala Glu Tyr Arg Arg Gln Thr Val Thr Ser Thr Pro Cys  
 675 680 685  
 Trp Ile Glu Leu His Leu Asn Gly Pro Leu Gln Trp Leu Asp Lys Val  
 690 695 700  
 Leu Thr Gln Met Gly Ser Pro Ser Val Arg Cys Ser Ser Met Ser  
 705 710 715

## (2) INFORMATION FOR SEQ ID NO:52:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2421 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2418
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:52:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	

65	70	75	80	
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG				288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu				
	85	90	95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG				336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu				
	100	105	110	
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC				384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly				
	115	120	125	
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC				432
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr				
	130	135	140	
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC				480
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn				
	145	150	155	160
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC				528
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser				
	165	170	175	
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC				576
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly				
	180	185	190	
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG				624
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu				
	195	200	205	
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC				672
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe				
	210	215	220	
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC				720
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser				
	225	230	235	240
GGA CTC AGA TCT CGA GCT CAA GCT TCG AAT TCG AAT TCA ACC ATG GAC				768
Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Asn Ser Thr Met Asp				
	245	250	255	
AAT ATG TCT ATT ACG AAT ACA CCA ACA AGT AAT GAT GCC TGT CTG AGC				816
Asn Met Ser Ile Thr Asn Thr Pro Thr Ser Asn Asp Ala Cys Leu Ser				
	260	265	270	
ATT GTG CAT AGT TTG ATG TGC CAT AGA CAA GGT GGA GAG AGT GAA ACA				864
Ile Val His Ser Leu Met Cys His Arg Gln Gly Gly Glu Ser Glu Thr				
	275	280	285	
TTT GCA AAA AGA GCA ATT GAA AGT TTG GTA AAG AAG CTG AAG GAG AAA				912
Phe Ala Lys Arg Ala Ile Glu Ser Leu Val Lys Lys Leu Lys Glu Lys				
	290	295	300	

960  
1008  
1056  
1104  
1152  
1200  
1248  
1296  
1344  
1392  
1440  
1488  
1536  
1584  
1632



530	535	540	
CAC CCG CCT ATG CCG CCC CAT CCC GGA CAT TAC TGG CCT GTT CAC AAT			1680
His Pro Pro Met Pro His Pro Gly His Tyr Trp Pro Val His Asn			
545	550	555	560
GAG CTT GCA TTC CAG CCT CCC ATT TCC AAT CAT CCT GCT CCT GAG TAT			1728
Glu Leu Ala Phe Gln Pro Pro Ile Ser Asn His Pro Ala Pro Glu Tyr			
565	570	575	
TGG TGT TCC ATT GCT TAC TTT GAA ATG GAT GTT CAG GTA GGA GAG ACA			1776
Trp Cys Ser Ile Ala Tyr Phe Glu Met Asp Val Gln Val Gly Glu Thr			
580	585	590	
TTT AAG GTT CCT TCA AGC TGC CCT ATT GTT ACT GTT GAT GGA TAC GTG			1824
Phe Lys Val Pro Ser Ser Cys Pro Ile Val Thr Val Asp Gly Tyr Val			
595	600	605	
GAC CCT TCT GGA GGA GAT CGC TTT TGT TTG GGT CAA CTC TCC AAT GTC			1872
Asp Pro Ser Gly Gly Asp Arg Phe Cys Leu Gly Gln Leu Ser Asn Val			
610	615	620	
CAC AGG ACA GAA GCC ATT GAG AGA GCA AGG TTG CAC ATA GGC AAA GGT			1920
His Arg Thr Glu Ala Ile Glu Arg Ala Arg Leu His Ile Gly Lys Gly			
625	630	635	640
GTG CAG TTG GAA TGT AAA GGT GAA GGT GAT GTT TGG GTC AGG TGC CTT			1968
Val Gln Leu Glu Cys Lys Gly Glu Gly Asp Val Trp Val Arg Cys Leu			
645	650	655	
AGT GAC CAC GCG GTC TTT GTA CAG AGT TAC TAC TTA GAC AGA GAA GCT			2016
Ser Asp His Ala Val Phe Val Gln Ser Tyr Tyr Leu Asp Arg Glu Ala			
660	665	670	
GGG CGT GCA CCT GGA GAT GCT GTT CAT AAG ATC TAC CCA AGT GCA TAT			2064
Gly Arg Ala Pro Gly Asp Ala Val His Lys Ile Tyr Pro Ser Ala Tyr			
675	680	685	
ATA AAG GTC TTT GAT TTG CGT CAG TGT CAT CGA CAG ATG CAG CAG CAG			2112
Ile Lys Val Phe Asp Leu Arg Gln Cys His Arg Gln Met Gln Gln Gln			
690	695	700	
GCG GCT ACT GCA CAA GCT GCA GCA GCT GCC CAG GCA GCA GCC GTG GCA			2160
Ala Ala Thr Ala Gln Ala Ala Ala Ala Gln Ala Ala Ala Val Ala			
705	710	715	720
GGA AAC ATC CCT GGC CCA GGA TCA GTA GGT GGA ATA GCT CCA GCT ATC			2208
Gly Asn Ile Pro Gly Pro Gly Ser Val Gly Gly Ile Ala Pro Ala Ile			
725	730	735	
AGT CTG TCA GCT GCT GCT GGA ATT GGT GTT GAT GAC CTT CGT CGC TTA			2256
Ser Leu Ser Ala Ala Ala Gly Ile Gly Val Asp Asp Leu Arg Arg Leu			
740	745	750	
TGC ATA CTC AGG ATG AGT TTT GTG AAA GGC TGG GGA CCG GAT TAC CCA			2304
Cys Ile Leu Arg Met Ser Phe Val Lys Gly Trp Gly Pro Asp Tyr Pro			
755	760	765	

AGA CAG AGC ATC AAA GAA ACA CCT TGC TGG ATT GAA ATT CAC TTA CAC 2352  
 Arg Gln Ser Ile Lys Glu Thr Pro Cys Trp Ile Glu Ile His Leu His  
 770 775 780

CGG GCC CTC CAG CTC CTA GAC GAA GTA CTT CAT ACC ATG CCG ATT GCA 2400  
 Arg Ala Leu Gln Leu Leu Asp Glu Val Leu His Thr Met Pro Ile Ala  
 785 790 795 800

GAC CCA CAA CCT TTA GAC TGA  
 Asp Pro Gln Pro Leu Asp 2421  
 805

## (2) INFORMATION FOR SEQ ID NO:53:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 806 amino acids  
 (B) TYPE: amino acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:53:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu  
 1 5 10 15  
 Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly  
 20 25 30  
 Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile  
 35 40 45  
 Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr  
 50 55 60  
 Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys  
 65 70 75 80  
 Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu  
 85 90 95  
 Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu  
 100 105 110  
 Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly  
 115 120 125  
 Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr  
 130 135 140  
 Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn  
 145 150 155 160  
 Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser  
 165 170 175  
 Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly  
 180 185 190  
 Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu  
 195 200 205  
 Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe  
 210 215 220  
 Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser  
 225 230 235 240  
 Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Asn Ser Thr Met Asp  
 245 250 255

Asn Met Ser Ile Thr Asn Thr Pro Thr Ser Asn Asp Ala Cys Leu Ser																			
	260						265							270					
Ile Val His Ser Leu Met Cys His Arg Gln Gly Gly Glu Ser Glu Thr																			
	275						280							285					
Phe Ala Lys Arg Ala Ile Glu Ser Leu Val Lys Lys Leu Lys Glu Lys																			
	290						295						300						
Lys Asp Glu Leu Asp Ser Leu Ile Thr Ala Ile Thr Thr Asn Gly Ala																			
305					310				315									320	
His Pro Ser Lys Cys Val Thr Ile Gln Arg Thr Leu Asp Gly Arg Leu																			
				325					330									335	
Gln Val Ala Gly Arg Lys Gly Phe Pro His Val Ile Tyr Ala Arg Leu																			
	340							345										350	
Trp Arg Trp Pro Asp Leu His Lys Asn Glu Leu Lys His Val Lys Tyr																			
	355						360											365	
Cys Gln Tyr Ala Phe Asp Leu Lys Cys Asp Ser Val Cys Val Asn Pro																			
	370					375							380						
Tyr His Tyr Glu Arg Val Val Ser Pro Gly Ile Asp Leu Ser Gly Leu																			
385					390				395										400
Thr Leu Gln Ser Asn Ala Pro Ser Ser Met Met Val Lys Asp Glu Tyr																			
				405					410									415	
Val His Asp Phe Glu Gly Gln Pro Ser Leu Ser Thr Glu Gly His Ser																			
				420					425									430	
Ile Gln Thr Ile Gln His Pro Pro Ser Asn Arg Ala Ser Thr Glu Thr																			
	435						440											445	
Tyr Ser Thr Pro Ala Leu Leu Ala Pro Ser Glu Ser Asn Ala Thr Ser																			
	450					455							460						
Thr Ala Asn Phe Pro Asn Ile Pro Val Ala Ser Thr Ser Gln Pro Ala																			
465					470				475										480
Ser Ile Leu Gly Gly Ser His Ser Glu Gly Leu Leu Gln Ile Ala Ser																			
				485					490									495	
Gly Pro Gln Pro Gly Gln Gln Gln Asn Gly Phe Thr Gly Gln Pro Ala																			
	500							505										510	
Thr Tyr His His Asn Ser Thr Thr Thr Trp Thr Gly Ser Arg Thr Ala																			
	515						520							525					
Pro Tyr Thr Pro Asn Leu Pro His His Gln Asn Gly His Leu Gln His																			
	530					535							540						
His Pro Pro Met Pro Pro His Pro Gly His Tyr Trp Pro Val His Asn																			
545					550				555										560
Glu Leu Ala Phe Gln Pro Pro Ile Ser Asn His Pro Ala Pro Glu Tyr																			
				565					570									575	
Trp Cys Ser Ile Ala Tyr Phe Glu Met Asp Val Gln Val Gly Glu Thr																			
	580								585									590	
Phe Lys Val Pro Ser Ser Cys Pro Ile Val Thr Val Asp Gly Tyr Val																			
	595						600							605					
Asp Pro Ser Gly Gly Asp Arg Phe Cys Leu Gly Gln Leu Ser Asn Val																			
	610					615								620					
His Arg Thr Glu Ala Ile Glu Arg Ala Arg Leu His Ile Gly Lys Gly																			
625					630				635										640
Val Gln Leu Glu Cys Lys Gly Glu Gly Asp Val Trp Val Arg Cys Leu																			
				645					650									655	
Ser Asp His Ala Val Phe Val Gln Ser Tyr Tyr Leu Asp Arg Glu Ala																			
	660								665									670	
Gly Arg Ala Pro Gly Asp Ala Val His Lys Ile Tyr Pro Ser Ala Tyr																			
	675						680							685					
Ile Lys Val Phe Asp Leu Arg Gln Cys His Arg Gln Met Gln Gln Gln																			
	690						695							700					
Ala Ala Thr Ala Gln Ala Ala Ala Ala Ala Gln Ala Ala Val Ala																			
705					710									715					720



GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125	384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT ACC ATG GCG GGC TGG ATC CAG GCC CAG CAG CTG CAG Gly Leu Arg Ser Thr Met Ala Gly Trp Ile Gln Ala Gln Gln Leu Gln 245 250 255	768
GGA GAC GCG CTG CGC CAG ATG CAG GTG CTG TAC GGC CAG CAC TTC CCC Gly Asp Ala Leu Arg Gln Met Gln Val Leu Tyr Gly Gln His Phe Pro 260 265 270	816
ATC GAG GTC CGG CAC TAC TTG GCC CAG TGG ATT GAG AGC CAG CCA TGG Ile Glu Val Arg His Tyr Leu Ala Gln Trp Ile Glu Ser Gln Pro Trp 275 280 285	864
GAT GCC ATT GAC TTG GAC AAT CCC CAG GAC AGA GCC CAA GCC ACC CAG Asp Ala Ile Asp Leu Asp Asn Pro Gln Asp Arg Ala Gln Ala Thr Gln 290 295 300	912
CTC CTG GAG GGC CTG GTG CAG GAG CTG CAG AAG AAG GCG GAG CAC CAG Leu Leu Glu Gly Leu Val Gln Glu Leu Gln Lys Lys Ala Glu His Gln 305 310 315 320	960
GTG GGG GAA GAT GGG TTT TTA CTG AAG ATC AAG CTG GGG CAC TAC GCC Val Gly Glu Asp Gly Phe Leu Leu Lys Ile Lys Leu Gly His Tyr Ala 325 330 335	1008
ACG CAG CTC CAG AAA ACA TAT GAC CGC TGC CCC CTG GAG CTG GTC CGC Thr Gln Leu Gln Lys Thr Tyr Asp Arg Cys Pro Leu Glu Leu Val Arg	1056

340	345	350	
TGC ATC CGG CAC ATT CTG TAC AAT GAA CAG AGG CTG GTC CGA GAA GCC Cys Ile Arg His Ile Leu Tyr Asn Glu Gln Arg Leu Val Arg Glu Ala 355 360 365			1104
AAC AAT TGC AGC TCT CCG GCT GGG ATC CTG GTT GAC GCC ATG TCC CAG Asn Asn Cys Ser Ser Pro Ala Gly Ile Leu Val Asp Ala Met Ser Gln 370 375 380			1152
AAG CAC CTT CAG ATC AAC CAG ACA TTT GAG GAG CTG CGA CTG GTC ACG Lys His Leu Gln Ile Asn Gln Thr Phe Glu Glu Leu Arg Leu Val Thr 385 390 395 400			1200
CAG GAC ACA GAG AAT GAG CTG AAG AAA CTG CAG CAG ACT CAG GAG TAC Gln Asp Thr Glu Asn Glu Leu Lys Lys Leu Gln Gln Thr Gln Glu Tyr 405 410 415			1248
TTC ATC ATC CAG TAC CAG GAG AGC CTG AGG ATC CAA GCT CAG TTT GCC Phe Ile Ile Gln Tyr Gln Glu Ser Leu Arg Ile Gln Ala Gln Phe Ala 420 425 430			1296
CAG CTG GCC CAG CTG AGC CCC CAG GAG CGT CTG AGC CGG GAG ACG GCC Gln Leu Ala Gln Leu Ser Pro Gln Glu Arg Leu Ser Arg Glu Thr Ala 435 440 445			1344
CTC CAG CAG AAG CAG GTG TCT CTG GAG GCC TGG TTG CAG CGT GAG GCA Leu Gln Gln Lys Gln Val Ser Leu Glu Ala Trp Leu Gln Arg Glu Ala 450 455 460			1392
CAG ACA CTG CAG CAG TAC CGC GTG GAG CTG GCC GAG AAG CAC CAG AAG Gln Thr Leu Gln Gln Tyr Arg Val Glu Leu Ala Glu Lys His Gln Lys 465 470 475 480			1440
ACC CTG CAG CTG CTG CGG AAG CAG CAG ACC ATC ATC CTG GAT GAC GAG Thr Leu Gln Leu Leu Arg Lys Gln Gln Thr Ile Ile Leu Asp Asp Glu 485 490 495			1488
CTG ATC CAG TGG AAG CGG CGG CAG CAG CTG GCC GGG AAC GGC GGG CCC Leu Ile Gln Trp Lys Arg Arg Gln Gln Leu Ala Gly Asn Gly Gly Pro 500 505 510			1536
CCC GAG GGC AGC CTG GAC GTG CTA CAG TCC TGG TGT GAG AAG TTG GCC Pro Glu Gly Ser Leu Asp Val Leu Gln Ser Trp Cys Glu Lys Leu Ala 515 520 525			1584
GAG ATC ATC TGG CAG AAC CGG CAG CAG ATC CGC AGG GCT GAG CAC CTC Glu Ile Ile Trp Gln Asn Arg Gln Gln Ile Arg Arg Ala Glu His Leu 530 535 540			1632
TGC CAG CAG CTG CCC ATC CCC GGC CCA GTG GAG GAG ATG CTG GCC GAG Cys Gln Gln Leu Pro Ile Pro Gly Pro Val Glu Glu Met Leu Ala Glu 545 550 555 560			1680
GTC AAC GCC ACC ATC ACG GAC ATT ATC TCA GCC CTG GTG ACC AGC ACA Val Asn Ala Thr Ile Thr Asp Ile Ile Ser Ala Leu Val Thr Ser Thr 565 570 575			1728

TTC	ATC	ATT	GAG	AAG	CAG	CCT	CCT	CAG	GTC	CTG	AAG	ACC	CAG	ACC	AAG	1776
Phe	Ile	Ile	Glu	Lys	Gln	Pro	Pro	Gln	Val	Leu	Lys	Thr	Gln	Thr	Lys	
			580					585					590			
TTT	GCA	GCC	ACC	GTA	CGC	CTG	CTG	GTG	GGC	GGG	AAG	CTG	AAC	GTG	CAC	1824
Phe	Ala	Ala	Thr	Val	Arg	Leu	Leu	Val	Gly	Gly	Lys	Leu	Asn	Val	His	
			595					600					605			
ATG	AAT	CCC	CCC	CAG	GTG	AAG	GCC	ACC	ATC	ATC	AGT	GAG	CAG	CAG	GCC	1872
Met	Asn	Pro	Pro	Gln	Val	Lys	Ala	Thr	Ile	Ile	Ser	Glu	Gln	Gln	Ala	
		610				615					620					
AAG	TCT	CTG	CTT	AAA	AAT	GAG	AAC	ACC	CGC	AAC	GAG	TGC	AGT	GGT	GAG	1920
Lys	Ser	Leu	Leu	Lys	Asn	Glu	Asn	Thr	Arg	Asn	Glu	Cys	Ser	Gly	Glu	
		625			630				635					640		
ATC	CTG	AAC	AAC	TGC	TGC	GTG	ATG	GAG	TAC	CAC	CAA	GCC	ACG	GGC	ACC	1968
Ile	Leu	Asn	Asn	Cys	Cys	Val	Met	Glu	Tyr	His	Gln	Ala	Thr	Gly	Thr	
				645				650						655		
CTC	AGT	GCC	CAC	TTC	AGG	AAC	ATG	TCA	CTG	AAG	AGG	ATC	AAG	CGT	GCT	2016
Leu	Ser	Ala	His	Phe	Arg	Asn	Met	Ser	Leu	Lys	Arg	Ile	Lys	Arg	Ala	
			660					665					670			
GAC	CGG	CGG	GGT	GCA	GAG	TCC	GTG	ACA	GAG	GAG	AAG	TTC	ACA	GTC	CTG	2064
Asp	Arg	Arg	Gly	Ala	Glu	Ser	Val	Thr	Glu	Glu	Lys	Phe	Thr	Val	Leu	
			675					680					685			
TTT	GAG	TCT	CAG	TTC	AGT	GTT	GGC	AGC	AAT	GAG	CTT	GTG	TTC	CAG	GTG	2112
Phe	Glu	Ser	Gln	Phe	Ser	Val	Gly	Ser	Asn	Glu	Leu	Val	Phe	Gln	Val	
		690				695					700					
AAG	ACT	CTG	TCC	CTA	CCT	GTG	GTT	GTC	ATC	GTC	CAC	GGC	AGC	CAG	GAC	2160
Lys	Thr	Leu	Ser	Leu	Pro	Val	Val	Val	Ile	Val	His	Gly	Ser	Gln	Asp	
		705			710				715					720		
CAC	AAT	GCC	ACG	GCT	ACT	GTG	CTG	TGG	GAC	AAT	GCC	TTT	GCT	GAG	CCG	2208
His	Asn	Ala	Thr	Ala	Thr	Val	Leu	Trp	Asp	Asn	Ala	Phe	Ala	Glu	Pro	
				725				730						735		
GGC	AGG	GTG	CCA	TTT	GCC	GTG	CCT	GAC	AAA	GTG	CTG	TGG	CCG	CAG	CTG	2256
Gly	Arg	Val	Pro	Phe	Ala	Val	Pro	Asp	Lys	Val	Leu	Trp	Pro	Gln	Leu	
			740					745						750		
TGT	GAG	GCG	CTC	AAC	ATG	AAA	TTC	AAG	GCC	GAA	GTG	CAG	AGC	AAC	CGG	2304
Cys	Glu	Ala	Leu	Asn	Met	Lys	Phe	Lys	Ala	Glu	Val	Gln	Ser	Asn	Arg	
			755				760					765				
GGC	CTG	ACC	AAG	GAG	AAC	CTC	GTG	TTC	CTG	GCG	CAG	AAA	CTG	TTC	AAC	2352
Gly	Leu	Thr	Lys	Glu	Asn	Leu	Val	Phe	Leu	Ala	Gln	Lys	Leu	Phe	Asn	
			770			775					780					
AAC	AGC	AGC	AGC	CAC	CTG	GAG	GAC	TAC	AGT	GGC	CTG	TCC	GTG	TCC	TGG	2400
Asn	Ser	Ser	Ser	His	Leu	Glu	Asp	Tyr	Ser	Gly	Leu	Ser	Val	Ser	Trp	
			785			790				795				800		
TCC	CAG	TTC	AAC	AGG	GAG	AAC	TTG	CCG	GGC	TGG	AAC	TAC	ACC	TTC	TGG	2448
Ser	Gln	Phe	Asn	Arg	Glu	Asn	Leu	Pro	Gly	Trp	Asn	Tyr	Thr	Phe	Trp	

805																810						815						
CAG	TGG	TTT	GAC	GGG	GTG	ATG	GAG	GTG	TTG	AAG	AAG	CAC	CAC	AAG	CCC	2496												
Gln	Trp	Phe	Asp	Gly	Val	Met	Glu	Val	Leu	Lys	Lys	His	His	Lys	Pro													
			820				825						830															
CAC	TGG	AAT	GAT	GGG	GCC	ATC	CTA	GGT	TTT	GTG	AAT	AAG	CAA	CAG	GCC	2544												
His	Trp	Asn	Asp	Gly	Ala	Ile	Leu	Gly	Phe	Val	Asn	Lys	Gln	Gln	Ala													
			835				840						845															
CAC	GAC	CTG	CTC	ATC	AAC	AAG	CCC	GAC	GGG	ACC	TTC	TTG	TTG	CGC	TTT	2592												
His	Asp	Leu	Leu	Ile	Asn	Lys	Pro	Asp	Gly	Thr	Phe	Leu	Leu	Arg	Phe													
			850				855						860															
AGT	GAC	TCA	GAA	ATC	GGG	GGC	ATC	ACC	ATC	GCC	TGG	AAG	TTT	GAC	TCC	2640												
Ser	Asp	Ser	Glu	Ile	Gly	Gly	Ile	Thr	Ile	Ala	Trp	Lys	Phe	Asp	Ser													
			865				870						880															
CCG	GAA	CGC	AAC	CTG	TGG	AAC	CTG	AAA	CCA	TTC	ACC	ACG	CGG	GAT	TTC	2688												
Pro	Glu	Arg	Asn	Leu	Trp	Asn	Leu	Lys	Pro	Phe	Thr	Thr	Arg	Asp	Phe													
			885							890			895															
TCC	ATC	AGG	TCC	CTG	GCT	GAC	CGG	CTG	GGG	GAC	CTG	AGC	TAT	CTC	ATC	2736												
Ser	Ile	Arg	Ser	Leu	Ala	Asp	Arg	Leu	Gly	Asp	Leu	Ser	Tyr	Leu	Ile													
			900							905			910															
TAT	GTG	TTT	CCT	GAC	CGC	CCC	AAG	GAT	GAG	GTC	TTC	TCC	AAG	TAC	TAC	2784												
Tyr	Val	Phe	Pro	Asp	Arg	Pro	Lys	Asp	Glu	Val	Phe	Ser	Lys	Tyr	Tyr													
			915							920			925															
ACT	CCT	GTG	CTG	GCT	AAA	GCT	GTT	GAT	GGA	TAT	GTG	AAA	CCA	CAG	ATC	2832												
Thr	Pro	Val	Leu	Ala	Lys	Ala	Val	Asp	Gly	Tyr	Val	Lys	Pro	Gln	Ile													
			930				935						940															
AAG	CAA	GTG	GTC	CCT	GAG	TTT	GTG	AAT	GCA	TCT	GCA	GAT	GCT	GGG	GGC	2880												
Lys	Gln	Val	Val	Pro	Glu	Phe	Val	Asn	Ala	Ser	Ala	Asp	Ala	Gly	Gly													
			945				950						955			960												
AGC	AGC	GCC	ACG	TAC	ATG	GAC	CAG	GCC	CCC	TCC	CCA	GCT	GTG	TGC	CCC	2928												
Ser	Ser	Ala	Thr	Tyr	Met	Asp	Gln	Ala	Pro	Ser	Pro	Ala	Val	Cys	Pro													
			965							970			975															
CAG	GCT	CCC	TAT	AAC	ATG	TAC	CCA	CAG	AAC	CCT	GAC	CAT	GTA	CTC	GAT	2976												
Gln	Ala	Pro	Tyr	Asn	Met	Tyr	Pro	Gln	Asn	Pro	Asp	His	Val	Leu	Asp													
			980							985			990															
CAG	GAT	GGA	GAA	TTC	GAC	CTG	GAT	GAG	ACC	ATG	GAT	GTG	GCC	AGG	CAC	3024												
Gln	Asp	Gly	Glu	Phe	Asp	Leu	Asp	Glu	Thr	Met	Asp	Val	Ala	Arg	His													
			995				1000						1005															
GTG	GAG	GAA	CTC	TTA	CGC	CGA	CCA	ATG	GAC	AGT	CTT	GAC	TCC	CGC	CTC	3072												
Val	Glu	Glu	Leu	Leu	Arg	Arg	Pro	Met	Asp	Ser	Leu	Asp	Ser	Arg	Leu													
			1010				1015						1020															
TCG	CCC	CCT	GCC	GGT	CTT	TTC	ACC	TCT	GCC	AGA	GGC	TCC	CTC	TCA	TGA	3120												
Ser	Pro	Pro	Ala	Gly	Leu	Phe	Thr	Ser	Ala	Arg	Gly	Ser	Leu	Ser														
1025				1030						1035						1												



## (2) INFORMATION FOR SEQ ID NO:55:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1039 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:55:

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Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
 1           5           10           15
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
 20           25           30
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
 35           40           45
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
 50           55           60
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
 65           70           75           80
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu
 85           90           95
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu
100           105           110
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly
115           120           125
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr
130           135           140
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn
145           150           155           160
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser
165           170           175
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly
180           185           190
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu
195           200           205
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe
210           215           220
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser
225           230           235           240
Gly Leu Arg Ser Thr Met Ala Gly Trp Ile Gln Ala Gln Gln Leu Gln
245           250           255
Gly Asp Ala Leu Arg Gln Met Gln Val Leu Tyr Gly Gln His Phe Pro
260           265           270
Ile Glu Val Arg His Tyr Leu Ala Gln Trp Ile Glu Ser Gln Pro Trp
275           280           285
Asp Ala Ile Asp Leu Asp Asn Pro Gln Asp Arg Ala Gln Ala Thr Gln
290           295           300
Leu Leu Glu Gly Leu Val Gln Glu Leu Gln Lys Lys Ala Glu His Gln
305           310           315           320
Val Gly Glu Asp Gly Phe Leu Leu Lys Ile Lys Leu Gly His Tyr Ala
325           330           335
Thr Gln Leu Gln Lys Thr Tyr Asp Arg Cys Pro Leu Glu Leu Val Arg
340           345           350

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Cys Ile Arg His Ile Leu Tyr Asn Glu Gln Arg Leu Val Arg Glu Ala  
 355 360 365  
 Asn Asn Cys Ser Ser Pro Ala Gly Ile Leu Val Asp Ala Met Ser Gln  
 370 375 380  
 Lys His Leu Gln Ile Asn Gln Thr Phe Glu Glu Leu Arg Leu Val Thr  
 385 390 395 400  
 Gln Asp Thr Glu Asn Glu Leu Lys Lys Leu Gln Gln Thr Gln Glu Tyr  
 405 410 415  
 Phe Ile Ile Gln Tyr Gln Glu Ser Leu Arg Ile Gln Ala Gln Phe Ala  
 420 425 430  
 Gln Leu Ala Gln Leu Ser Pro Gln Glu Arg Leu Ser Arg Glu Thr Ala  
 435 440 445  
 Leu Gln Gln Lys Gln Val Ser Leu Glu Ala Trp Leu Gln Arg Glu Ala  
 450 455 460  
 Gln Thr Leu Gln Gln Tyr Arg Val Glu Leu Ala Glu Lys His Gln Lys  
 465 470 475 480  
 Thr Leu Gln Leu Leu Arg Lys Gln Gln Thr Ile Ile Leu Asp Asp Glu  
 485 490 495  
 Leu Ile Gln Trp Lys Arg Arg Gln Gln Leu Ala Gly Asn Gly Gly Pro  
 500 505 510  
 Pro Glu Gly Ser Leu Asp Val Leu Gln Ser Trp Cys Glu Lys Leu Ala  
 515 520 525  
 Glu Ile Ile Trp Gln Asn Arg Gln Gln Ile Arg Arg Ala Glu His Leu  
 530 535 540  
 Cys Gln Gln Leu Pro Ile Pro Gly Pro Val Glu Glu Met Leu Ala Glu  
 545 550 555 560  
 Val Asn Ala Thr Ile Thr Asp Ile Ile Ser Ala Leu Val Thr Ser Thr  
 565 570 575  
 Phe Ile Ile Glu Lys Gln Pro Pro Gln Val Leu Lys Thr Gln Thr Lys  
 580 585 590  
 Phe Ala Ala Thr Val Arg Leu Leu Val Gly Gly Lys Leu Asn Val His  
 595 600 605  
 Met Asn Pro Pro Gln Val Lys Ala Thr Ile Ile Ser Glu Gln Gln Ala  
 610 615 620  
 Lys Ser Leu Leu Lys Asn Glu Asn Thr Arg Asn Glu Cys Ser Gly Glu  
 625 630 635 640  
 Ile Leu Asn Asn Cys Cys Val Met Glu Tyr His Gln Ala Thr Gly Thr  
 645 650 655  
 Leu Ser Ala His Phe Arg Asn Met Ser Leu Lys Arg Ile Lys Arg Ala  
 660 665 670  
 Asp Arg Arg Gly Ala Glu Ser Val Thr Glu Glu Lys Phe Thr Val Leu  
 675 680 685  
 Phe Glu Ser Gln Phe Ser Val Gly Ser Asn Glu Leu Val Phe Gln Val  
 690 695 700  
 Lys Thr Leu Ser Leu Pro Val Val Val Ile Val His Gly Ser Gln Asp  
 705 710 715 720  
 His Asn Ala Thr Ala Thr Val Leu Trp Asp Asn Ala Phe Ala Glu Pro  
 725 730 735  
 Gly Arg Val Pro Phe Ala Val Pro Asp Lys Val Leu Trp Pro Gln Leu  
 740 745 750  
 Cys Glu Ala Leu Asn Met Lys Phe Lys Ala Glu Val Gln Ser Asn Arg  
 755 760 765  
 Gly Leu Thr Lys Glu Asn Leu Val Phe Leu Ala Gln Lys Leu Phe Asn  
 770 775 780  
 Asn Ser Ser Ser His Leu Glu Asp Tyr Ser Gly Leu Ser Val Ser Trp  
 785 790 795 800  
 Ser Gln Phe Asn Arg Glu Asn Leu Pro Gly Trp Asn Tyr Thr Phe Trp  
 805 810 815

Gln Trp Phe Asp Gly Val Met Glu Val Leu Lys Lys His His Lys Pro  
 820 825 830  
 His Trp Asn Asp Gly Ala Ile Leu Gly Phe Val Asn Lys Gln Gln Ala  
 835 840 845  
 His Asp Leu Leu Ile Asn Lys Pro Asp Gly Thr Phe Leu Leu Arg Phe  
 850 855 860  
 Ser Asp Ser Glu Ile Gly Gly Ile Thr Ile Ala Trp Lys Phe Asp Ser  
 865 870 875 880  
 Pro Glu Arg Asn Leu Trp Asn Leu Lys Pro Phe Thr Thr Arg Asp Phe  
 885 890 895  
 Ser Ile Arg Ser Leu Ala Asp Arg Leu Gly Asp Leu Ser Tyr Leu Ile  
 900 905 910  
 Tyr Val Phe Pro Asp Arg Pro Lys Asp Glu Val Phe Ser Lys Tyr Tyr  
 915 920 925  
 Thr Pro Val Leu Ala Lys Ala Val Asp Gly Tyr Val Lys Pro Gln Ile  
 930 935 940  
 Lys Gln Val Val Pro Glu Phe Val Asn Ala Ser Ala Asp Ala Gly Gly  
 945 950 955 960  
 Ser Ser Ala Thr Tyr Met Asp Gln Ala Pro Ser Pro Ala Val Cys Pro  
 965 970 975  
 Gln Ala Pro Tyr Asn Met Tyr Pro Gln Asn Pro Asp His Val Leu Asp  
 980 985 990  
 Gln Asp Gly Glu Phe Asp Leu Asp Glu Thr Met Asp Val Ala Arg His  
 995 1000 1005  
 Val Glu Glu Leu Leu Arg Arg Pro Met Asp Ser Leu Asp Ser Arg Leu  
 1010 1015 1020  
 Ser Pro Pro Ala Gly Leu Phe Thr Ser Ala Arg Gly Ser Leu Ser  
 025 1030 1035 1

## (2) INFORMATION FOR SEQ ID NO:56:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1875 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1872
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:56:

ATG GCG GCG GCG GCG GCT CCG GGG GGC GGG GGC GGG GAG CCC AGG	48
Met Ala Ala Ala Ala Ala Pro Gly Gly Gly Gly Glu Pro Arg	
1 5 10 15	
GGA ACT GCT GGG GTC GTC CCG GTG GTC CCC GGG GAG GTG GAG GTG GTG	96
Gly Thr Ala Gly Val Val Pro Val Val Pro Gly Glu Val Glu Val Val	
20 25 30	
AAG GGG CAG CCA TTC GAT GTG GGC CCA CGC TAC ACG CAG CTG CAG TAC	144
Lys Gly Gln Pro Phe Asp Val Gly Pro Arg Tyr Thr Gln Leu Gln Tyr	
35 40 45	

ATC GGC GAG GGC GCG TAC GGC ATG GTC AGC TCA GCT TAT GAC CAC GTG Ile Gly Glu Gly Ala Tyr Gly Met Val Ser Ser Ala Tyr Asp His Val 50 55 60	192
CGC AAG ACC AGA GTG GCC ATC AAG AAG ATC AGC CCC TTT GAG CAT CAA Arg Lys Thr Arg Val Ala Ile Lys Lys Ile Ser Pro Phe Glu His Gln 65 70 75 80	240
ACC TAC TGT CAG CGC ACG CTG AGG GAG ATC CAG ATC TTG CTG CGA TTC Thr Tyr Cys Gln Arg Thr Leu Arg Glu Ile Gln Ile Leu Leu Arg Phe 85 90 95	288
CGC CAT GAG AAT GTT ATA GGC ATC CGA GAC ATC CTC AGA GCG CCC ACC Arg His Glu Asn Val Ile Gly Ile Arg Asp Ile Leu Arg Ala Pro Thr 100 105 110	336
CTG GAA GCC ATG AGA GAT GTT TAC ATT GTT CAG GAC CTC ATG GAG ACA Leu Glu Ala Met Arg Asp Val Tyr Ile Val Gln Asp Leu Met Glu Thr 115 120 125	384
GAC CTG TAC AAG CTG CTT AAA AGC CAG CAG CTG AGC AAT GAC CAC ATC Asp Leu Tyr Lys Leu Leu Lys Ser Gln Gln Leu Ser Asn Asp His Ile 130 135 140	432
TGC TAC TTC CTC TAC CAG ATC CTC CGG GGC CTC AAG TAT ATA CAC TCA Cys Tyr Phe Leu Tyr Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser 145 150 155 160	480
GCC AAT GTG CTG CAC CGG GAC CTG AAG CCT TCC AAT CTG CTT ATC AAC Ala Asn Val Leu His Arg Asp Leu Lys Pro Ser Asn Leu Leu Ile Asn 165 170 175	528
ACC ACC TGC GAC CTT AAG ATC TGT GAT TTT GGC CTG GCC CGG ATT GCT Thr Thr Cys Asp Leu Lys Ile Cys Asp Phe Gly Leu Ala Arg Ile Ala 180 185 190	576
GAC CCT GAG CAC GAC CAC ACT GGC TTT CTG ACG GAG TAT GTG GCC ACA Asp Pro Glu His Asp His Thr Gly Phe Leu Thr Glu Tyr Val Ala Thr 195 200 205	624
CGC TGG TAC CGA GCC CCA GAG ATC ATG CTT AAT TCC AAG GGC TAC ACC Arg Trp Tyr Arg Ala Pro Glu Ile Met Leu Asn Ser Lys Gly Tyr Thr 210 215 220	672
AAA TCC ATC GAC ATC TGG TCT GTG GGC TGC ATT CTG GCT GAG ATG CTC Lys Ser Ile Asp Ile Trp Ser Val Gly Cys Ile Leu Ala Glu Met Leu 225 230 235 240	720
TCC AAC CGG CCC ATC TTC CCC GGC AAG CAC TAC CTG GAC CAG CTC AAC Ser Asn Arg Pro Ile Phe Pro Gly Lys His Tyr Leu Asp Gln Leu Asn 245 250 255	768
CAC ATT CTA GGT ATC TTG GGT TCC CCA TCC CAG GAG GAC CTT AAT TGC His Ile Leu Gly Ile Leu Gly Ser Pro Ser Gln Glu Asp Leu Asn Cys 260 265 270	816
ATC ATT AAC ATG AAG GCC CGA AAC TAC CTG CAG TCT CTG CCC TCG AAA Ile Ile Asn Met Lys Ala Arg Asn Tyr Leu Gln Ser Leu Pro Ser Lys 270	864

275	280	285	
ACC AAG GTG GCT TGG GCC AAG CTC TTT CCT AAA TCT GAC TCC AAA GCT Thr Lys Val Ala Trp Ala Lys Leu Phe Pro Lys Ser Asp Ser Lys Ala 290 295 300			912
CTT GAC CTG CTG GAC CGG ATG TTA ACC TTC AAC CCA AAC AAG CGC ATC Leu Asp Leu Leu Asp Arg Met Leu Thr Phe Asn Pro Asn Lys Arg Ile 305 310 315 320			960
ACA GTA GAG GAA GCG CTG GCT CAC CCT TAC CTG GAA CAG TAC TAC GAT Thr Val Glu Glu Ala Leu Ala His Pro Tyr Leu Glu Gln Tyr Tyr Asp 325 330 335			1008
CCG ACA GAT GAG CCA GTG GCC GAG GAG CCA TTC ACC TTC GAC ATG GAG Pro Thr Asp Glu Pro Val Ala Glu Glu Pro Phe Thr Phe Asp Met Glu 340 345 350			1056
CTG GAT GAC CTC CCC AAG GAG CGG CTG AAG GAG TTG ATC TTC CAG GAG Leu Asp Asp Leu Pro Lys Glu Arg Leu Lys Glu Leu Ile Phe Gln Glu 355 360 365			1104
ACA GCC CGC TTC CAG CCA GGG GCG CCA GAG GGC CCC GGG CGC GCC ATG Thr Ala Arg Phe Gln Pro Gly Ala Pro Glu Gly Pro Gly Arg Ala Met 370 375 380			1152
AGT AAA GGA GAA GAA CTT TTC ACT GGA GTT GTC CCA ATT CTT GTT GAA Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu 385 390 395 400			1200
TTA GAT GGC GAT GTT AAT GGG CAA AAA TTC TCT GTT AGT GGA GAG GGT Leu Asp Gly Asp Val Asn Gly Gln Lys Phe Ser Val Ser Gly Glu Gly 405 410 415			1248
GAA GGT GAT GCA ACA TAC GGA AAA CTT ACC CTT AAA TTT ATT TGC ACT Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr 420 425 430			1296
ACT GGG AAG CTA CCT GTT CCA TGG CCA ACG CTT GTC ACT ACT CTC ACT Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr 435 440 445			1344
TAT GGT GTT CAA TGC TTT TCT AGA TAC CCA GAT CAT ATG AAA CAG CAT Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His 450 455 460			1392
GAC TTT TTC AAG AGT GCC ATG CCC GAA GGT TAT GTA CAG GAA AGA ACT Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr 465 470 475 480			1440
ATA TTT TAC AAA GAT GAC GGG AAC TAC AAG ACA CGT GCT GAA GTC AAG Ile Phe Tyr Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys 485 490 495			1488
TTT GAA GGT GAT ACC CTT GTT AAT AGA ATC GAG TTA AAA GGT ATT GAT Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp 500 505 510			1536

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TTT AAA GAA GAT GGA AAC ATT CTT GGA CAC AAA ATG GAA TAC AAT TAT 1584
Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Met Glu Tyr Asn Tyr
      515                520                525

AAC TCA CAT AAT GTA TAC ATC ATG GCA GAC AAA CCA AAG AAT GGC ATC 1632
Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Pro Lys Asn Gly Ile
      530                535                540

AAA GTT AAC TTC AAA ATT AGA CAC AAC ATT AAA GAT GGA AGC GTT CAA 1680
Lys Val Asn Phe Lys Ile Arg His Asn Ile Lys Asp Gly Ser Val Gln
      545                550                555                560

TTA GCA GAC CAT TAT CAA CAA AAT ACT CCA ATT GGC GAT GGC CCT GTC 1728
Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val
      565                570                575

CTT TTA CCA GAC AAC CAT TAC CTG TCC ACG CAA TCT GCC CTT TCC AAA 1776
Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys
      580                585                590

GAT CCC AAC GAA AAG AGA GAT CAC ATG ATC CTT CTT GAG TTT GTA ACA 1824
Asp Pro Asn Glu Lys Arg Asp His Met Ile Leu Leu Glu Phe Val Thr
      595                600                605

GCT GCT GGG ATT ACA CAT GGC ATG GAT GAA CTA TAC AAA CCT CAG GAG T 1873
Ala Ala Gly Ile Thr His Gly Met Asp Glu Leu Tyr Lys Pro Gln Glu
      610                615                620

AA 1875

```

## (2) INFORMATION FOR SEQ ID NO:57:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 624 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:57:

```

Met Ala Ala Ala Ala Ala Pro Gly Gly Gly Gly Glu Pro Arg
 1          5          10          15
Gly Thr Ala Gly Val Val Pro Val Val Pro Gly Glu Val Glu Val Val
      20          25          30
Lys Gly Gln Pro Phe Asp Val Gly Pro Arg Tyr Thr Gln Leu Gln Tyr
      35          40          45
Ile Gly Glu Gly Ala Tyr Gly Met Val Ser Ser Ala Tyr Asp His Val
      50          55          60
Arg Lys Thr Arg Val Ala Ile Lys Lys Ile Ser Pro Phe Glu His Gln
      65          70          75          80
Thr Tyr Cys Gln Arg Thr Leu Arg Glu Ile Gln Ile Leu Leu Arg Phe
      85          90          95
Arg His Glu Asn Val Ile Gly Ile Arg Asp Ile Leu Arg Ala Pro Thr
      100         105         110
Leu Glu Ala Met Arg Asp Val Tyr Ile Val Gln Asp Leu Met Glu Thr

```

115	120	125
Asp Leu Tyr Lys Leu Leu Lys Ser Gln Gln Leu Ser Asn Asp His Ile		
130	135	140
Cys Tyr Phe Leu Tyr Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser		
145	150	155
Ala Asn Val Leu His Arg Asp Leu Lys Pro Ser Asn Leu Leu Ile Asn		160
165	170	175
Thr Thr Cys Asp Leu Lys Ile Cys Asp Phe Gly Leu Ala Arg Ile Ala		
180	185	190
Asp Pro Glu His Asp His Thr Gly Phe Leu Thr Glu Tyr Val Ala Thr		
195	200	205
Arg Trp Tyr Arg Ala Pro Glu Ile Met Leu Asn Ser Lys Gly Tyr Thr		
210	215	220
Lys Ser Ile Asp Ile Trp Ser Val Gly Cys Ile Leu Ala Glu Met Leu		
225	230	235
Ser Asn Arg Pro Ile Phe Pro Gly Lys His Tyr Leu Asp Gln Leu Asn		240
245	250	255
His Ile Leu Gly Ile Leu Gly Ser Pro Ser Gln Glu Asp Leu Asn Cys		
260	265	270
Ile Ile Asn Met Lys Ala Arg Asn Tyr Leu Gln Ser Leu Pro Ser Lys		
275	280	285
Thr Lys Val Ala Trp Ala Lys Leu Phe Pro Lys Ser Asp Ser Lys Ala		
290	295	300
Leu Asp Leu Leu Asp Arg Met Leu Thr Phe Asn Pro Asn Lys Arg Ile		
305	310	315
Thr Val Glu Glu Ala Leu Ala His Pro Tyr Leu Glu Gln Tyr Tyr Asp		320
325	330	335
Pro Thr Asp Glu Pro Val Ala Glu Glu Pro Phe Thr Phe Asp Met Glu		
340	345	350
Leu Asp Asp Leu Pro Lys Glu Arg Leu Lys Glu Leu Ile Phe Gln Glu		
355	360	365
Thr Ala Arg Phe Gln Pro Gly Ala Pro Glu Gly Pro Gly Arg Ala Met		
370	375	380
Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu		
385	390	395
Leu Asp Gly Asp Val Asn Gly Gln Lys Phe Ser Val Ser Gly Glu Gly		400
405	410	415
Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr		
420	425	430
Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr		
435	440	445
Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His		
450	455	460
Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr		
465	470	475
Ile Phe Tyr Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys		480
485	490	495
Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp		
500	505	510
Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Met Glu Tyr Asn Tyr		
515	520	525
Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Pro Lys Asn Gly Ile		
530	535	540
Lys Val Asn Phe Lys Ile Arg His Asn Ile Lys Asp Gly Ser Val Gln		
545	550	555
Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val		560
565	570	575
Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys		





CAC CGT GAC CTC AAG CCT TCC AAC CTC CTG CTG AAC ACC ACT TGT GAT	480
His Arg Asp Leu Lys Pro Ser Asn Leu Leu Leu Asn Thr Thr Cys Asp	
145 150 155 160	
CTC AAG ATC TGT GAC TTT GGC CTT GCC CGT GTT GCA GAT CCA GAC CAT	528
Leu Lys Ile Cys Asp Phe Gly Leu Ala Arg Val Ala Asp Pro Asp His	
165 170 175	
GAT CAT ACA GGG TTC TTG ACA GAG TAT GTA GCC ACG CGT TGG TAC AGA	576
Asp His Thr Phe Leu Thr Glu Tyr Val Ala Thr Arg Trp Tyr Arg	
180 185 190	
GCT CCA GAA ATT ATG TTG AAT TCC AAG GGT TAT ACC AAG TCC ATT GAT	624
Ala Pro Glu Ile Met Leu Asn Ser Lys Gly Tyr Thr Lys Ser Ile Asp	
195 200 205	
ATT TGG TCT GTG GGC TGC ATC CTG GCA GAG ATG CTA TCC AAC AGG CCT	672
Ile Trp Ser Val Gly Cys Ile Leu Ala Glu Met Leu Ser Asn Arg Pro	
210 215 220	
ATC TTC CCA GGA AAG CAT TAC CTT GAC CAG CTG AAT CAC ATC CTG GGT	720
Ile Phe Pro Gly Lys His Tyr Leu Asp Gln Leu Asn His Ile Leu Gly	
225 230 235 240	
ATT CTT GGA TCT CCA TCA CAG GAA GAT CTG AAT TGT ATA ATA AAT TTA	768
Ile Leu Gly Ser Pro Ser Gln Glu Asp Leu Asn Cys Ile Ile Asn Leu	
245 250 255	
AAA GCT AGA AAC TAT TTG CTT TCT CTC CCG CAC AAA AAT AAG GTG CCG	816
Lys Ala Arg Asn Tyr Leu Leu Ser Leu Pro His Lys Asn Lys Val Pro	
260 265 270	
TGG AAC AGG TTG TTC CCA AAC GCT GAC TCC AAA GCT CTG GAT TTA CTG	864
Trp Asn Arg Leu Phe Pro Asn Ala Asp Ser Lys Ala Leu Asp Leu Leu	
275 280 285	
GAT AAA ATG TTG ACA TTT AAC CCT CAC AAG AGG ATT GAA GTT GAA CAG	912
Asp Lys Met Leu Thr Phe Asn Pro His Lys Arg Ile Glu Val Glu Gln	
290 295 300	
GCT CTG GCC CAC CCG TAC CTG GAG CAG TAT TAT GAC CCA AGT GAT GAG	960
Ala Leu Ala His Pro Tyr Leu Glu Gln Tyr Tyr Asp Pro Ser Asp Glu	
305 310 315 320	
CCC ATT GCT GAA GCA CCA TTC AAG TTT GAC ATG GAG CTG GAC GAC TTA	1008
Pro Ile Ala Glu Ala Pro Phe Lys Phe Asp Met Glu Leu Asp Asp Leu	
325 330 335	
CCT AAG GAG AAG CTC AAA GAA CTC ATT TTT GAA GAG ACT GCT CGA TTC	1056
Pro Lys Glu Lys Leu Lys Glu Leu Ile Phe Glu Glu Thr Ala Arg Phe	
340 345 350	
CAG CCA GGA TAC AGA TCT ATG GAT CCA CCG GTC GCC ACC ATG GTG AGC	1104
Gln Pro Gly Tyr Arg Ser Met Asp Pro Pro Val Ala Thr Met Val Ser	
355 360 365	
AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG GTC GAG CTG	1152

Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu	
370 375 380	
GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC GAG GGC GAG	1200
Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu	
385 390 395 400	
GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC TGC ACC ACC	1248
Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr	
405 410 415	
GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC CTG ACC TAC	1296
Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr	
420 425 430	
GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG CAG CAC GAC	1344
Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His Asp	
435 440 445	
TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC	1392
Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile	
450 455 460	
TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC	1440
Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe	
465 470 475 480	
GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC	1488
Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe	
485 490 495	
AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC	1536
Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn	
500 505 510	
AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG	1584
Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys	
515 520 525	
GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC	1632
Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu	
530 535 540	
GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG	1680
Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu	
545 550 555 560	
CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC	1728
Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp	
565 570 575	
CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC	1776
Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala	
580 585 590	
GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AA GTAA	1815
Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys	
595 600	

## (2) INFORMATION FOR SEQ ID NO:59:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 604 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:59:

```

Met Ala Ala Ala Ala Ala Gly Pro Glu Met Val Arg Gly Gln Val
 1           5           10           15
Phe Asp Val Gly Pro Arg Tyr Thr Asn Leu Ser Tyr Ile Gly Glu Gly
          20           25           30
Ala Tyr Gly Met Val Cys Ser Ala Tyr Asp Asn Leu Asn Lys Val Arg
          35           40           45
Val Ala Ile Lys Lys Ile Ser Pro Phe Glu His Gln Thr Tyr Cys Gln
          50           55           60
Arg Thr Leu Arg Glu Ile Lys Ile Leu Leu Arg Phe Arg His Glu Asn
65           70           75           80
Ile Ile Gly Ile Asn Asp Ile Ile Arg Ala Pro Thr Ile Glu Gln Met
          85           90           95
Lys Asp Val Tyr Ile Val Gln Asp Leu Met Glu Thr Asp Leu Tyr Lys
          100          105          110
Leu Leu Lys Thr Gln His Leu Ser Asn Asp His Ile Cys Tyr Phe Leu
          115          120          125
Tyr Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser Ala Asn Val Leu
          130          135          140
His Arg Asp Leu Lys Pro Ser Asn Leu Leu Leu Asn Thr Thr Cys Asp
145          150          155          160
Leu Lys Ile Cys Asp Phe Gly Leu Ala Arg Val Ala Asp Pro Asp His
          165          170          175
Asp His Thr Gly Phe Leu Thr Glu Tyr Val Ala Thr Arg Trp Tyr Arg
          180          185          190
Ala Pro Glu Ile Met Leu Asn Ser Lys Gly Tyr Thr Lys Ser Ile Asp
          195          200          205
Ile Trp Ser Val Gly Cys Ile Leu Ala Glu Met Leu Ser Asn Arg Pro
          210          215          220
Ile Phe Pro Gly Lys His Tyr Leu Asp Gln Leu Asn His Ile Leu Gly
225          230          235          240
Ile Leu Gly Ser Pro Ser Gln Glu Asp Leu Asn Cys Ile Ile Asn Leu
          245          250          255
Lys Ala Arg Asn Tyr Leu Leu Ser Leu Pro His Lys Asn Lys Val Pro
          260          265          270
Trp Asn Arg Leu Phe Pro Asn Ala Asp Ser Lys Ala Leu Asp Leu Leu
          275          280          285
Asp Lys Met Leu Thr Phe Asn Pro His Lys Arg Ile Glu Val Glu Gln
          290          295          300
Ala Leu Ala His Pro Tyr Leu Glu Gln Tyr Tyr Asp Pro Ser Asp Glu
305          310          315          320
Pro Ile Ala Glu Ala Pro Phe Lys Phe Asp Met Glu Leu Asp Asp Leu
          325          330          335
Pro Lys Glu Lys Leu Lys Glu Leu Ile Phe Glu Glu Thr Ala Arg Phe

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(2) INFORMATION FOR SEO ID NO:60:

(A) LENGTH: 2511 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ix) FEATURE:

(A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...2508  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEO ID NO:60:

ATG	GAG	CTG	GAA	AAC	ATC	GTG	GCC	AAC	ACG	GTC	TTG	CTG	AAA	GCC	AGG	48
Met	Glu	Leu	Glu	Asn	Ile	Val	Ala	Asn	Thr	Val	Leu	Leu	Lys	Ala	Arg	
1				5					10					15		
GAA	GGG	GGC	GGA	GGA	AAG	CGC	AAA	GGG	AAA	AGC	AAG	AAG	TGG	AAA	GAA	96
Glu	Gly	Gly	Gly	Gly	Lys	Arg	Lys	Gly	Lys	Ser	Lys	Lys	Trp	Lys	Glu	
			20					25					30			

ATC CTG AAG TTC CCT CAC ATT AGC CAG TGT GAA GAC CTC CGA AGG ACC Ile Leu Lys Phe Pro His Ile Ser Gln Cys Glu Asp Leu Arg Arg Thr 35 40 45	144
ATA GAC AGA GAT TAC TGC AGT TTA TGT GAC AAG CAG CCA ATC GGG AGG Ile Asp Arg Asp Tyr Cys Ser Leu Cys Asp Lys Gln Pro Ile Gly Arg 50 55 60	192
CTG CTT TTC CGG CAG TTT TGT GAA ACC AGG CCT GGG CTG GAG TGT TAC Leu Leu Phe Arg Gln Phe Cys Glu Thr Arg Pro Gly Leu Glu Cys Tyr 65 70 75 80	240
ATT CAG TTC CTG GAC TCC GTG GCA GAA TAT GAA GTT ACT CCA GAT GAA Ile Gln Phe Leu Asp Ser Val Ala Glu Tyr Glu Val Thr Pro Asp Glu 85 90 95	288
AAA CTG GGA GAG AAA GGG AAG GAA ATT ATG ACC AAG TAC CTC ACC CCA Lys Leu Gly Glu Lys Gly Lys Glu Ile Met Thr Lys Tyr Leu Thr Pro 100 105 110	336
AAG TCC CCT GTT TTC ATA GCC CAA GTT GGC CAA GAC CTG GTC TCC CAG Lys Ser Pro Val Phe Ile Ala Gln Val Gly Gln Asp Leu Val Ser Gln 115 120 125	384
ACG GAG GAG AAG CTC CTA CAG AAG CCG TGC AAA GAA CTC TTT TCT GCC Thr Glu Glu Lys Leu Leu Gln Lys Pro Cys Lys Glu Leu Phe Ser Ala 130 135 140	432
TGT GCA CAG TCT GTC CAC GAG TAC CTG AGG GGA GAA CCA TTC CAC GAA Cys Ala Gln Ser Val His Glu Tyr Leu Arg Gly Glu Pro Phe His Glu 145 150 155 160	480
TAT CTG GAC AGC ATG TTT TTT GAC CGC TTT CTC CAG TGG AAG TGG TTG Tyr Leu Asp Ser Met Phe Phe Asp Arg Phe Leu Gln Trp Lys Trp Leu 165 170 175	528
GAA AGG CAA CCG GTG ACC AAA AAC ACT TTC AGG CAG TAT CGA GTG CTA Glu Arg Gln Pro Val Thr Lys Asn Thr Phe Arg Gln Tyr Arg Val Leu 180 185 190	576
GGA AAA GGG GGC TTC GGG GAG GTC TGT GCC TGC CAG GTT CGG GCC ACG Gly Lys Gly Gly Phe Gly Glu Val Cys Ala Cys Gln Val Arg Ala Thr 195 200 205	624
GGT AAA ATG TAT GCC TGC AAG CGC TTG GAG AAG AAG AGG ATC AAA AAG Gly Lys Met Tyr Ala Cys Lys Arg Leu Glu Lys Lys Arg Ile Lys Lys 210 215 220	672
AGG AAA GGG GAG TCC ATG GCC CTC AAT GAG AAG CAG ATC CTC GAG AAG Arg Lys Gly Glu Ser Met Ala Leu Asn Glu Lys Gln Ile Leu Glu Lys 225 230 235 240	720
GTC AAC AGT CAG TTT GTG GTC AAC CTG GCC TAT GCC TAC GAG ACC AAG Val Asn Ser Gln Phe Val Val Asn Leu Ala Tyr Ala Tyr Glu Thr Lys 245 250 255	768
GAT GCA CTG TGC TTG GTC CTG ACC ATC ATG AAT GGG GGT GAC CTG AAG	816

Asp	Ala	Leu	Cys	Leu	Val	Leu	Thr	Ile	Met	Asn	Gly	Gly	Asp	Leu	Lys	
		260						265					270			
TTC	CAC	ATC	TAC	AAC	ATG	GGC	AAC	CCT	GGC	TTC	GAG	GAG	GAG	CGG	GCC	864
Phe	His	Ile	Tyr	Asn	Met	Gly	Asn	Pro	Gly	Phe	Glu	Glu	Glu	Arg	Ala	
		275					280				285					
TTG	TTT	TAT	GCG	GCA	GAG	ATC	CTC	TGC	GGC	TTA	GAA	GAC	CTC	CAC	CGT	912
Leu	Phe	Tyr	Ala	Ala	Glu	Ile	Leu	Cys	Gly	Leu	Glu	Asp	Leu	His	Arg	
		290				295					300					
GAG	AAC	ACC	GTC	TAC	CGA	GAT	CTG	AAA	CCT	GAA	AAC	ATC	CTG	TTA	GAT	960
Glu	Asn	Thr	Val	Tyr	Arg	Asp	Leu	Lys	Pro	Glu	Asn	Ile	Leu	Leu	Asp	
305					310					315					320	
GAT	TAT	GGC	CAC	ATT	AGG	ATC	TCA	GAC	CTG	GGC	TTG	GCT	GTG	AAG	ATC	1008
Asp	Tyr	Gly	His	Ile	Arg	Ile	Ser	Asp	Leu	Gly	Leu	Ala	Val	Lys	Ile	
				325					330					335		
CCC	GAG	GGA	GAC	CTG	ATC	CGC	GGC	CGG	GTG	GGC	ACT	GTT	GGC	TAC	ATG	1056
Pro	Glu	Gly	Asp	Leu	Ile	Arg	Gly	Arg	Val	Gly	Thr	Val	Gly	Tyr	Met	
			340					345					350			
GCC	CCC	GAA	GTC	CTG	AAC	AAC	CAG	AGG	TAC	GGC	CTG	AGC	CCC	GAC	TAC	1104
Ala	Pro	Glu	Val	Leu	Asn	Asn	Gln	Arg	Tyr	Gly	Leu	Ser	Pro	Asp	Tyr	
		355					360					365				
TGG	GGC	CTT	GGC	TGC	CTC	ATC	TAT	GAG	ATG	ATC	GAG	GGC	CAG	TCG	CCG	1152
Trp	Gly	Leu	Gly	Cys	Leu	Ile	Tyr	Glu	Met	Ile	Glu	Gly	Gln	Ser	Pro	
		370				375					380					
TTC	CGC	GGC	CGT	AAG	GAG	AAG	GTG	AAG	CGG	GAG	GAG	GTG	GAC	CGC	CGG	1200
Phe	Arg	Gly	Arg	Lys	Glu	Lys	Val	Lys	Arg	Glu	Glu	Val	Asp	Arg	Arg	
385					390					395					400	
GTC	CTG	GAG	ACG	GAG	GAG	GTG	TAC	TCC	CAC	AAG	TTC	TCC	GAG	GAG	GCC	1248
Val	Leu	Glu	Thr	Glu	Glu	Val	Tyr	Ser	His	Lys	Phe	Ser	Glu	Glu	Ala	
				405					410					415		
AAG	TCC	ATC	TGC	AAG	ATG	CTG	CTC	ACG	AAA	GAT	GCG	AAG	CAG	AGG	CTG	1296
Lys	Ser	Ile	Cys	Lys	Met	Leu	Leu	Thr	Lys	Asp	Ala	Lys	Gln	Arg	Leu	
			420					425					430			
GGC	TGC	CAG	GAG	GAG	GGG	GCT	GCA	GAG	GTC	AAG	AGA	CAC	CCC	TTC	TTC	1344
Gly	Cys	Gln	Glu	Glu	Gly	Ala	Ala	Glu	Val	Lys	Arg	His	Pro	Phe	Phe	
		435				440						445				
AGG	AAC	ATG	AAC	TTC	AAG	CGC	TTA	GAA	GCC	GGG	ATG	TTG	GAC	CCT	CCC	1392
Arg	Asn	Met	Asn	Phe	Lys	Arg	Leu	Glu	Ala	Gly	Met	Leu	Asp	Pro	Pro	
		450				455					460					
TTC	GTT	CCA	GAC	CCC	CGC	GCT	GTG	TAC	TGT	AAG	GAC	GTG	CTG	GAC	ATC	1440
Phe	Val	Pro	Asp	Pro	Arg	Ala	Val	Tyr	Cys	Lys	Asp	Val	Leu	Asp	Ile	
465					470					475					480	
GAG	CAG	TTC	TCC	ACT	GTG	AAG	GGC	GTC	AAT	CTG	GAC	CAC	ACA	GAC	GAC	1488
Glu	Gln	Phe	Ser	Thr	Val	Lys	Gly	Val	Asn	Leu	Asp	His	Thr	Asp	Asp	
				485				490						495		

GAC TTC TAC TCC AAG TTC TCC ACG GGC TCT GTG TCC ATC CCA TGG CAA	1536
Asp Phe Tyr Ser Lys Phe Ser Thr Gly Ser Val Ser Ile Pro Trp Gln	
500 505 510	
AAC GAG ATG ATA GAA ACA GAA TGC TTT AAG GAG CTG AAC GTG TTT GGA	1584
Asn Glu Met Ile Glu Thr Glu Cys Phe Lys Glu Leu Asn Val Phe Gly	
515 520 525	
CCT AAT GGT ACC CTC CCG CCA GAT CTG AAC AGA AAC CAC CCT CCG GAA	1632
Pro Asn Gly Thr Leu Pro Pro Asp Leu Asn Arg Asn His Pro Pro Glu	
530 535 540	
CCG CCC AAG AAA GGG CTG CTC CAG AGA CTC TTC AAG CGG CAG CAT CAG	1680
Pro Pro Lys Lys Gly Leu Leu Gln Arg Leu Phe Lys Arg Gln His Gln	
545 550 555 560	
AAC AAT TCC AAG AGT TCG CCC AGC TCC AAG ACC AGT TTT AAC CAC CAC	1728
Asn Asn Ser Lys Ser Ser Pro Ser Ser Lys Thr Ser Phe Asn His His	
565 570 575	
ATA AAC TCA AAC CAT GTC AGC TCG AAC TCC ACC GGA AGC AGC AGG GAT	1776
Ile Asn Ser Asn His Val Ser Ser Asn Ser Thr Gly Ser Ser Arg Asp	
580 585 590	
CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG	1824
Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly	
595 600 605	
GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG	1872
Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His Lys	
610 615 620	
TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG	1920
Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu	
625 630 635 640	
ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC	1968
Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro	
645 650 655	
ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC	2016
Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr	
660 665 670	
CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA	2064
Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu	
675 680 685	
GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC	2112
Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr	
690 695 700	
AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC	2160
Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg	
705 710 715 720	
ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG	2208

Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly	
725 730 735	
CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC	2256
His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala	
740 745 750	
GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC	2304
Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn	
755 760 765	
ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC	2352
Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr	
770 775 780	
CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC	2400
Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser	
785 790 795 800	
ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG	2448
Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met	
805 810 815	
GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC	2496
Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp	
820 825 830	
GAG CTG TAC AAG TAA	2511
Glu Leu Tyr Lys	
835	

## (2) INFORMATION FOR SEQ ID NO:61:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 836 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:61:

Met Glu Leu Glu Asn Ile Val Ala Asn Thr Val Leu Leu Lys Ala Arg	
1 5 10 15	
Glu Gly Gly Gly Gly Lys Arg Lys Gly Lys Ser Lys Lys Trp Lys Glu	
20 25 30	
Ile Leu Lys Phe Pro His Ile Ser Gln Cys Glu Asp Leu Arg Arg Thr	
35 40 45	
Ile Asp Arg Asp Tyr Cys Ser Leu Cys Asp Lys Gln Pro Ile Gly Arg	
50 55 60	
Leu Leu Phe Arg Gln Phe Cys Glu Thr Arg Pro Gly Leu Glu Cys Tyr	
65 70 75 80	
Ile Gln Phe Leu Asp Ser Val Ala Glu Tyr Glu Val Thr Pro Asp Glu	
85 90 95	
Lys Leu Gly Glu Lys Gly Lys Glu Ile Met Thr Lys Tyr Leu Thr Pro	



[illegible]

[illegible]

(2) INFORMATION FOR SEQ ID NO:62:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1893 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...1890  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEO ID NO:62:

ATG	AGC	AGA	AGC	AAG	CGT	GAC	AAC	AAT	TTT	TAT	AGT	GTA	GAG	ATT	GGA	48
Met	Ser	Arg	Ser	Lys	Arg	Asp	Asn	Asn	Phe	Tyr	Ser	Val	Glu	Ile	Gly	
1				5					10					15		
GAT	TCT	ACA	TTC	ACA	GTC	CTG	AAA	CGA	TAT	CAG	AAT	TTA	AAA	CCT	ATA	96

Asp Ser Thr Phe Thr Val Leu Lys Arg Tyr Gln Asn Leu Lys Pro Ile	
20 25 30	
GGC TCA GGA GCT CAA GGA ATA GTA TGC GCA GCT TAT GAT GCC ATT CTT	144
Gly Ser Gly Ala Gln Gly Ile Val Cys Ala Ala Tyr Asp Ala Ile Leu	
35 40 45	
GAA AGA AAT GTT GCA ATC AAG AAG CTA AGC CGA CCA TTT CAG AAT CAG	192
Glu Arg Asn Val Ala Ile Lys Lys Leu Ser Arg Pro Phe Gln Asn Gln	
50 55 60	
ACT CAT GCC AAG CGG GCC TAC AGA GAG CTA GTT CTT ATG AAA TGT GTT	240
Thr His Ala Lys Arg Ala Tyr Arg Glu Leu Val Leu Met Lys Cys Val	
65 70 75 80	
AAT CAC AAA AAT ATA ATT GGC CTT TTG AAT GTT TTC ACA CCA CAG AAA	288
Asn His Lys Asn Ile Ile Gly Leu Leu Asn Val Phe Thr Pro Gln Lys	
85 90 95	
TCC CTA GAA GAA TTT CAA GAT GTT TAC ATA GTC ATG GAG CTC ATG GAT	336
Ser Leu Glu Glu Phe Gln Asp Val Tyr Ile Val Met Glu Leu Met Asp	
100 105 110	
GCA AAT CTT TGC CAA GTG ATT CAG ATG GAG CTA GAT CAT GAA AGA ATG	384
Ala Asn Leu Cys Gln Val Ile Gln Met Glu Leu Asp His Glu Arg Met	
115 120 125	
TCC TAC CTT CTC TAT CAG ATG CTG TGT GGA ATC AAG CAC CTT CAT TCT	432
Ser Tyr Leu Leu Tyr Gln Met Leu Cys Gly Ile Lys His Leu His Ser	
130 135 140	
GCT GGA ATT ATT CAT CGG GAC TTA AAG CCC AGT AAT ATA GTA GTA AAA	480
Ala Gly Ile Ile His Arg Asp Leu Lys Pro Ser Asn Ile Val Val Lys	
145 150 155 160	
TCT GAT TGC ACT TTG AAG ATT CTT GAC TTC GGT CTG GCC AGG ACT GCA	528
Ser Asp Cys Thr Leu Lys Ile Leu Asp Phe Gly Leu Ala Arg Thr Ala	
165 170 175	
GGA ACG AGT TTT ATG ATG ACG CCT TAT GTA GTG ACT CGC TAC TAC AGA	576
Gly Thr Ser Phe Met Met Thr Pro Tyr Val Val Thr Arg Tyr Tyr Arg	
180 185 190	
GCA CCC GAG GTC ATC CTT GGC ATG GGC TAC AAG GAA AAC GTG GAT TTA	624
Ala Pro Glu Val Ile Leu Gly Met Gly Tyr Lys Glu Asn Val Asp Leu	
195 200 205	
TGG TCT GTG GGG TGC ATT ATG GGA GAA ATG GTT TGC CAC AAA ATC CTC	672
Trp Ser Val Gly Cys Ile Met Gly Glu Met Val Cys His Lys Ile Leu	
210 215 220	
TTT CCA GGA AGG GAC TAT ATT GAT CAG TGG AAT AAA GTT ATT GAA CAG	720
Phe Pro Gly Arg Asp Tyr Ile Asp Gln Trp Asn Lys Val Ile Glu Gln	
225 230 235 240	
CTT GGA ACA CCA TGT CCT GAA TTC ATG AAG AAA CTG CAA CCA ACA GTA	768
Leu Gly Thr Pro Cys Pro Glu Phe Met Lys Lys Leu Gln Pro Thr Val	
245 250 255	

AGG	ACT	TAC	GTT	GAA	AAC	AGA	CCT	AAA	TAT	GCT	GGA	TAT	AGC	TTT	GAG	816
Arg	Thr	Tyr	Val	Glu	Asn	Arg	Pro	Lys	Tyr	Ala	Gly	Tyr	Ser	Phe	Glu	
			260					265					270			
AAA	CTC	TTC	CCT	GAT	GTC	CTT	TTC	CCA	GCT	GAC	TCA	GAA	CAC	AAC	AAA	864
Lys	Leu	Phe	Pro	Asp	Val	Leu	Phe	Pro	Ala	Asp	Ser	Glu	His	Asn	Lys	
		275					280					285				
CTT	AAA	GCC	AGT	CAG	GCA	AGG	GAT	TTG	TTA	TCC	AAA	ATG	CTG	GTA	ATA	912
Leu	Lys	Ala	Ser	Gln	Ala	Arg	Asp	Leu	Leu	Ser	Lys	Met	Leu	Val	Ile	
	290					295					300					
GAT	GCA	TCT	AAA	AGG	ATC	TCT	GTA	GAT	GAA	GCT	CTC	CAA	CAC	CCG	TAC	960
Asp	Ala	Ser	Lys	Arg	Ile	Ser	Val	Asp	Glu	Ala	Leu	Gln	His	Pro	Tyr	
305					310					315					320	
ATC	AAT	GTC	TGG	TAT	GAT	CCT	TCT	GAA	GCA	GAA	GCT	CCA	CCA	CCA	AAG	1008
Ile	Asn	Val	Trp	Tyr	Asp	Pro	Ser	Glu	Ala	Glu	Ala	Pro	Pro	Pro	Lys	
			325					330						335		
ATC	CCT	GAC	AAG	CAG	TTA	GAT	GAA	AGG	GAA	CAC	ACA	ATA	GAA	GAG	TGG	1056
Ile	Pro	Asp	Lys	Gln	Leu	Asp	Glu	Arg	Glu	His	Thr	Ile	Glu	Glu	Trp	
			340					345					350			
AAA	GAA	TTG	ATA	TAT	AAG	GAA	GTT	ATG	GAC	TTG	GAG	GAG	AGA	ACC	AAG	1104
Lys	Glu	Leu	Ile	Tyr	Lys	Glu	Val	Met	Asp	Leu	Glu	Glu	Arg	Thr	Lys	
		355					360					365				
AAT	GGA	GTT	ATA	CGG	GGG	CAG	CCC	TCT	CCT	TTA	GCA	CAG	GTG	CAG	CAG	1152
Asn	Gly	Val	Ile	Arg	Gly	Gln	Pro	Ser	Pro	Leu	Ala	Gln	Val	Gln	Gln	
	370					375					380					
TGG	GAT	CCA	CCG	GTC	GCC	ACC	ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	1200
Trp	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	
385					390					395					400	
ACC	GGG	GTG	GTG	CCC	ATC	CTG	GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	1248
Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	
			405						410					415		
CAC	AAG	TTC	AGC	GTG	TCC	GGC	GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	1296
His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	
			420					425						430		
AAG	CTG	ACC	CTG	AAG	TTC	ATC	TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	1344
Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	
		435					440					445				
TGG	CCC	ACC	CTC	GTG	ACC	ACC	CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	1392
Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	
	450					455					460					
CGC	TAC	CCC	GAC	CAC	ATG	AAG	CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	1440
Arg	Tyr	Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	
465					470					475				480		
CCC	GAA	GGC	TAC	GTC	CAG	GAG	CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	1488

Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly		
				485					490						495		
AAC	TAC	AAG	ACC	CGC	GCC	GAG	GTG	AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	1536	
Asn	Tyr	Lys	Thr	Arg	Ala	Glu	Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val		
			500					505					510				
AAC	CGC	ATC	GAG	CTG	AAG	GGC	ATC	GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	1584	
Asn	Arg	Ile	Glu	Leu	Lys	Gly	Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile		
		515					520					525					
CTG	GGG	CAC	AAG	CTG	GAG	TAC	AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	1632	
Leu	Gly	His	Lys	Leu	Glu	Tyr	Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile		
	530					535					540						
ATG	GCC	GAC	AAG	CAG	AAG	AAC	GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	1680	
Met	Ala	Asp	Lys	Gln	Lys	Asn	Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg		
545				550					555					560			
CAC	AAC	ATC	GAG	GAC	GGC	AGC	GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	1728	
His	Asn	Ile	Glu	Asp	Gly	Ser	Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln		
			565					570					575				
AAC	ACC	CCC	ATC	GGC	GAC	GGC	CCC	GTG	CTG	CTG	CCC	GAC	AAC	CAC	TAC	1776	
Asn	Thr	Pro	Ile	Gly	Asp	Gly	Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr		
			580				585					590					
CTG	AGC	ACC	CAG	TCC	GCC	CTG	AGC	AAA	GAC	CCC	AAC	GAG	AAG	CGC	GAT	1824	
Leu	Ser	Thr	Gln	Ser	Ala	Leu	Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp		
		595				600						605					
CAC	ATG	GTC	CTG	CTG	GAG	TTC	GTG	ACC	GCC	GCC	GGG	ATC	ACT	CTC	GGC	1872	
His	Met	Val	Leu	Leu	Glu	Phe	Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly		
	610					615					620						
ATG	GAC	GAG	CTG	TAC	AAG	TAA										1893	
Met	Asp	Glu	Leu	Tyr	Lys												
625					630												

## (2) INFORMATION FOR SEQ ID NO:63:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 630 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:63:

Met	Ser	Arg	Ser	Lys	Arg	Asp	Asn	Asn	Phe	Tyr	Ser	Val	Glu	Ile	Gly		
1				5					10					15			
Asp	Ser	Thr	Phe	Thr	Val	Leu	Lys	Arg	Tyr	Gln	Asn	Leu	Lys	Pro	Ile		
			20				25					30					
Gly	Ser	Gly	Ala	Gln	Gly	Ile	Val	Cys	Ala	Ala	Tyr	Asp	Ala	Ile	Leu		

35						40						45					
Glu	Arg	Asn	Val	Ala	Ile	Lys	Lys	Leu	Ser	Arg	Pro	Phe	Gln	Asn	Gln		
50						55						60					
Thr	His	Ala	Lys	Arg	Ala	Tyr	Arg	Glu	Leu	Val	Leu	Met	Lys	Cys	Val		
65	70					75					80						
Asn	His	Lys	Asn	Ile	Ile	Gly	Leu	Leu	Asn	Val	Phe	Thr	Pro	Gln	Lys		
85					90					95							
Ser	Leu	Glu	Glu	Phe	Gln	Asp	Val	Tyr	Ile	Val	Met	Glu	Leu	Met	Asp		
100					105					110							
Ala	Asn	Leu	Cys	Gln	Val	Ile	Gln	Met	Glu	Leu	Asp	His	Glu	Arg	Met		
115					120					125							
Ser	Tyr	Leu	Leu	Tyr	Gln	Met	Leu	Cys	Gly	Ile	Lys	His	Leu	His	Ser		
130					135					140							
Ala	Gly	Ile	Ile	His	Arg	Asp	Leu	Lys	Pro	Ser	Asn	Ile	Val	Val	Lys		
145	150					155					160						
Ser	Asp	Cys	Thr	Leu	Lys	Ile	Leu	Asp	Phe	Gly	Leu	Ala	Arg	Thr	Ala		
165					170					175							
Gly	Thr	Ser	Phe	Met	Met	Thr	Pro	Tyr	Val	Val	Thr	Arg	Tyr	Tyr	Arg		
180					185					190							
Ala	Pro	Glu	Val	Ile	Leu	Gly	Met	Gly	Tyr	Lys	Glu	Asn	Val	Asp	Leu		
195					200					205							
Trp	Ser	Val	Gly	Cys	Ile	Met	Gly	Glu	Met	Val	Cys	His	Lys	Ile	Leu		
210					215					220							
Phe	Pro	Gly	Arg	Asp	Tyr	Ile	Asp	Gln	Trp	Asn	Lys	Val	Ile	Glu	Gln		
225	230					235					240						
Leu	Gly	Thr	Pro	Cys	Pro	Glu	Phe	Met	Lys	Lys	Leu	Gln	Pro	Thr	Val		
245					250					255							
Arg	Thr	Tyr	Val	Glu	Asn	Arg	Pro	Lys	Tyr	Ala	Gly	Tyr	Ser	Phe	Glu		
260					265					270							
Lys	Leu	Phe	Pro	Asp	Val	Leu	Phe	Pro	Ala	Asp	Ser	Glu	His	Asn	Lys		
275					280					285							
Leu	Lys	Ala	Ser	Gln	Ala	Arg	Asp	Leu	Leu	Ser	Lys	Met	Leu	Val	Ile		
290					295					300							
Asp	Ala	Ser	Lys	Arg	Ile	Ser	Val	Asp	Glu	Ala	Leu	Gln	His	Pro	Tyr		
305	310					315					320						
Ile	Asn	Val	Trp	Tyr	Asp	Pro	Ser	Glu	Ala	Glu	Ala	Pro	Pro	Pro	Lys		
325					330					335							
Ile	Pro	Asp	Lys	Gln	Leu	Asp	Glu	Arg	Glu	His	Thr	Ile	Glu	Glu	Trp		
340					345					350							
Lys	Glu	Leu	Ile	Tyr	Lys	Glu	Val	Met	Asp	Leu	Glu	Glu	Arg	Thr	Lys		
355					360					365							
Asn	Gly	Val	Ile	Arg	Gly	Gln	Pro	Ser	Pro	Leu	Ala	Gln	Val	Gln	Gln		
370					375					380							
Trp	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe		
385	390					395					400						
Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly		
405					410					415							
His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly		
420					425					430							
Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro		
435					440					445							
Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser		
450					455					460							
Arg	Tyr	Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met		
465	470					475					480						
Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly		
485					490					495							
Asn	Tyr	Lys	Thr	Arg	Ala	Glu	Val	Lys	Phe	Glu	Gly	As					

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          500          505          510
Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile
          515          520          525
Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile
          530          535          540
Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg
545          550          555          560
His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln
          565          570          575
Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr
          580          585          590
Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp
          595          600          605
His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly
          610          615          620
Met Asp Glu Leu Tyr Lys
625          630

```

## (2) INFORMATION FOR SEQ ID NO:64:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1821 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1818
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:64:

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ATG TCT CAG GAG AGG CCC ACG TTC TAC CGG CAG GAG CTG AAC AAG ACA      48
Met Ser Gln Glu Arg Pro Thr Phe Tyr Arg Gln Glu Leu Asn Lys Thr
  1              5              10              15

ATC TGG GAG GTG CCC GAG CGT TAC CAG AAC CTG TCT CCA GTG GGC TCT      96
Ile Trp Glu Val Pro Glu Arg Tyr Gln Asn Leu Ser Pro Val Gly Ser
  20              25              30

GGC GCC TAT GGC TCT GTG TGT GCT GCT TTT GAC ACA AAA ACG GGG TTA     144
Gly Ala Tyr Gly Ser Val Cys Ala Ala Phe Asp Thr Lys Thr Gly Leu
  35              40              45

CGT GTG GCA GTG AAG AAG CTC TCC AGA CCA TTT CAG TCC ATC ATT CAT     192
Arg Val Ala Val Lys Lys Leu Ser Arg Pro Phe Gln Ser Ile Ile His
  50              55              60

GCG AAA AGA ACC TAC AGA GAA CTG CGG TTA CTT AAA CAT ATG AAA CAT     240
Ala Lys Arg Thr Tyr Arg Glu Leu Arg Leu Leu Lys His Met Lys His
  65              70              75              80

GAA AAT GTG ATT GGT CTG TTG GAC GTT TTT ACA CCT GCA AGG TCT CTG     288
Glu Asn Val Ile Gly Leu Leu Asp Val Phe Thr Pro Ala Arg Ser Leu
  85              90              95

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GAG GAA TTC AAT GAT GTG TAT CTG GTG ACC CAT CTC ATG GGG GCA GAT Glu Glu Phe Asn Asp Val Tyr Leu Val Thr His Leu Met Gly Ala Asp 100 105 110	336
CTG AAC AAC ATT GTG AAA TGT CAG AAG CTT ACA GAT GAC CAT GTT CAG Leu Asn Asn Ile Val Lys Cys Gln Lys Leu Thr Asp Asp His Val Gln 115 120 125	384
TTC CTT ATC TAC CAA ATT CTC CGA GGT CTA AAG TAT ATA CAT TCA GCT Phe Leu Ile Tyr Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser Ala 130 135 140	432
GAC ATA ATT CAC AGG GAC CTA AAA CCT AGT AAT CTA GCT GTG AAT GAA Asp Ile Ile His Arg Asp Leu Lys Pro Ser Asn Leu Ala Val Asn Glu 145 150 155 160	480
GAC TGT GAG CTG AAG ATT CTG GAT TTT GGA CTG GCT CGG CAC ACA GAT Asp Cys Glu Leu Lys Ile Leu Asp Phe Gly Leu Ala Arg His Thr Asp 165 170 175	528
GAT GAA ATG ACA GGC TAC GTG GCC ACT AGG TGG TAC AGG GCT CCT GAG Asp Glu Met Thr Gly Tyr Val Ala Thr Arg Trp Tyr Arg Ala Pro Glu 180 185 190	576
ATC ATG CTG AAC TGG ATG CAT TAC AAC CAG ACA GTT GAT ATT TGG TCA Ile Met Leu Asn Trp Met His Tyr Asn Gln Thr Val Asp Ile Trp Ser 195 200 205	624
GTG GGA TGC ATA ATG GCC GAG CTG TTG ACT GGA AGA ACA TTG TTT CCT Val Gly Cys Ile Met Ala Glu Leu Leu Thr Gly Arg Thr Leu Phe Pro 210 215 220	672
GGT ACA GAC CAT ATT GAT CAG TTG AAG CTC ATT TTA AGA CTC GTT GGA Gly Thr Asp His Ile Asp Gln Leu Lys Leu Ile Leu Arg Leu Val Gly 225 230 235 240	720
ACC CCA GGG GCT GAG CTT TTG AAG AAA ATC TCC TCA GAG TCT GCA AGA Thr Pro Gly Ala Glu Leu Leu Lys Lys Ile Ser Ser Glu Ser Ala Arg 245 250 255	768
AAC TAT ATT CAG TCT TTG ACT CAG ATG CCG AAG ATG AAC TTT GCG AAT Asn Tyr Ile Gln Ser Leu Thr Gln Met Pro Lys Met Asn Phe Ala Asn 260 265 270	816
GTA TTT ATT GGT GCC AAT CCC CTG GCT GTC GAC TTG CTG GAG AAG ATG Val Phe Ile Gly Ala Asn Pro Leu Ala Val Asp Leu Leu Glu Lys Met 275 280 285	864
CTT GTA TTG GAC TCA GAT AAG AGA ATT ACA GCG GCC CAA GCC CTT GCA Leu Val Leu Asp Ser Asp Lys Arg Ile Thr Ala Ala Gln Ala Leu Ala 290 295 300	912
CAT GCC TAC TTT GCT CAG TAC CAC GAT CCT GAT GAT GAA CCA GTG GCC His Ala Tyr Phe Ala Gln Tyr His Asp Pro Asp Asp Glu Pro Val Ala 305 310 315 320	960
GAT CCT TAT GAT CAG TCC TTT GAA AGC AGG GAC CTC CTT ATA GAT GAG	1008



Asp	Pro	Tyr	Asp	Gln	Ser	Phe	Glu	Ser	Arg	Asp	Leu	Leu	Ile	Asp	Glu		
				325					330					335			
TGG	AAA	AGC	CTG	ACC	TAT	GAT	GAA	GTC	ATC	AGC	TTT	GTG	CCA	CCA	CCC	1056	
Trp	Lys	Ser	Leu	Thr	Tyr	Asp	Glu	Val	Ile	Ser	Phe	Val	Pro	Pro	Pro		
			340					345				350					
CTT	GAC	CAA	GAA	GAG	ATG	GAG	TCC	GAG	GAT	CCA	CCG	GTC	GCC	ACC	ATG	1104	
Leu	Asp	Gln	Glu	Glu	Met	Glu	Ser	Glu	Asp	Pro	Pro	Val	Ala	Thr	Met		
		355					360					365					
GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	GTC	1152	
Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val		
		370				375					380						
GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	GAG	1200	
Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu		
		385				390				395					400		
GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	TGC	1248	
Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys		
			405					410					415				
ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	CTG	1296	
Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu		
			420					425				430					
ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	CAG	1344	
Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	Gln		
		435					440				445						
CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	CGC	1392	
His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg		
		450				455					460						
ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	AAG	ACC	CGC	GCC	GAG	GTG	1440	
Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	Val		
					470					475				480			
AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	CGC	ATC	GAG	CTG	AAG	GGC	ATC	1488	
Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	Ile		
				485				490					495				
GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	CTG	GGG	CAC	AAG	CTG	GAG	TAC	AAC	1536	
Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	Asn		
			500					505				510					
TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	GCC	GAC	AAG	CAG	AAG	AAC	GGC	1584	
Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	Gly		
		515					520					525					
ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	AAC	ATC	GAG	GAC	GGC	AGC	GTG	1632	
Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	Val		
		530				535					540						
CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	ACC	CCC	ATC	GGC	GAC	GGC	CCC	1680	
Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	Pro		
		545				550				555					560		

GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC 1728  
 Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser  
                   565                                  570                                  575

AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG 1776  
 Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val  
                   580                                  585                                  590

ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA 1821  
 Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys  
                   595                                  600                                  605

## (2) INFORMATION FOR SEQ ID NO:65:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 606 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:65:

Met Ser Gln Glu Arg Pro Thr Phe Tyr Arg Gln Glu Leu Asn Lys Thr  
 1                  5                  10                  15  
 Ile Trp Glu Val Pro Glu Arg Tyr Gln Asn Leu Ser Pro Val Gly Ser  
                   20                  25                  30  
 Gly Ala Tyr Gly Ser Val Cys Ala Ala Phe Asp Thr Lys Thr Gly Leu  
                   35                  40                  45  
 Arg Val Ala Val Lys Lys Leu Ser Arg Pro Phe Gln Ser Ile Ile His  
                   50                  55                  60  
 Ala Lys Arg Thr Tyr Arg Glu Leu Arg Leu Leu Lys His Met Lys His  
 65                  70                  75                  80  
 Glu Asn Val Ile Gly Leu Leu Asp Val Phe Thr Pro Ala Arg Ser Leu  
                   85                  90                  95  
 Glu Glu Phe Asn Asp Val Tyr Leu Val Thr His Leu Met Gly Ala Asp  
                   100                  105                  110  
 Leu Asn Asn Ile Val Lys Cys Gln Lys Leu Thr Asp Asp His Val Gln  
                   115                  120                  125  
 Phe Leu Ile Tyr Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser Ala  
                   130                  135                  140  
 Asp Ile Ile His Arg Asp Leu Lys Pro Ser Asn Leu Ala Val Asn Glu  
 145                  150                  155                  160  
 Asp Cys Glu Leu Lys Ile Leu Asp Phe Gly Leu Ala Arg His Thr Asp  
                   165                  170                  175  
 Asp Glu Met Thr Gly Tyr Val Ala Thr Arg Trp Tyr Arg Ala Pro Glu  
                   180                  185                  190  
 Ile Met Leu Asn Trp Met His Tyr Asn Gln Thr Val Asp Ile Trp Ser  
                   195                  200                  205  
 Val Gly Cys Ile Met Ala Glu Leu Leu Thr Gly Arg Thr Leu Phe Pro  
                   210                  215                  220  
 Gly Thr Asp His Ile Asp Gln Leu Lys Leu Ile Leu Arg Leu Val Gly  
 225                  230                  235                  240  
 Thr Pro Gly Ala Glu Leu Leu Lys Lys Ile Ser Ser Glu Ser Ala Arg

					245						250						255
Asn	Tyr	Ile	Gln	Ser	Leu	Thr	Gln	Met	Pro	Lys	Met	Asn	Phe	Ala	Asn		
			260					265						270			
Val	Phe	Ile	Gly	Ala	Asn	Pro	Leu	Ala	Val	Asp	Leu	Leu	Glu	Lys	Met		
		275						280					285				
Leu	Val	Leu	Asp	Ser	Asp	Lys	Arg	Ile	Thr	Ala	Ala	Gln	Ala	Leu	Ala		
		290				295					300						
His	Ala	Tyr	Phe	Ala	Gln	Tyr	His	Asp	Pro	Asp	Asp	Glu	Pro	Val	Ala		
305					310					315					320		
Asp	Pro	Tyr	Asp	Gln	Ser	Phe	Glu	Ser	Arg	Asp	Leu	Leu	Ile	Asp	Glu		
			325						330					335			
Trp	Lys	Ser	Leu	Thr	Tyr	Asp	Glu	Val	Ile	Ser	Phe	Val	Pro	Pro	Pro		
			340					345					350				
Leu	Asp	Gln	Glu	Glu	Met	Glu	Ser	Glu	Asp	Pro	Pro	Val	Ala	Thr	Met		
		355						360				365					
Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val		
		370				375					380						
Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu		
385				390						395					400		
Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys		
			405						410					415			
Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu		
		420						425					430				
Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	Gln		
		435					440					445					
His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg		
		450				455				460							
Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	Val		
465				470					475					480			
Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	Ile		
			485						490				495				
Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	Asn		
		500						505					510				
Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	Gly		
		515						520				525					
Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	Val		
		530				535					540						
Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	Pro		
545				550						555					560		
Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	Ser		
			565						570				575				
Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	Val		
		580						585					590				
Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys				
		595					600					605					

## (2) INFORMATION FOR SEQ ID NO:66:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2913 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence

(B) LOCATION: 1...2910

(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:66:

ATG AGT GCT GAG GGG TAC CAG TAC AGA GCG CTG TAT GAT TAT AAA AAG	48
Met Ser Ala Glu Gly Tyr Gln Tyr Arg Ala Leu Tyr Asp Tyr Lys Lys	
1 5 10 15	
GAA AGA GAA GAA GAT ATT GAC TTG CAC TTG GGT GAC ATA TTG ACT GTG	96
Glu Arg Glu Glu Asp Ile Asp Leu His Leu Gly Asp Ile Leu Thr Val	
20 25 30	
AAT AAA GGG TCC TTA GTA GCT CTT GGA TTC AGT GAT GGA CAG GAA GCC	144
Asn Lys Gly Ser Leu Val Ala Leu Gly Phe Ser Asp Gly Gln Glu Ala	
35 40 45	
AGG CCT GAA GAA ATT GGC TGG TTA AAT GGC TAT AAT GAA ACC ACA GGG	192
Arg Pro Glu Glu Ile Gly Trp Leu Asn Gly Tyr Asn Glu Thr Thr Gly	
50 55 60	
GAA AGG GGG GAC TTT CCG GGA ACT TAC GTA GAA TAT ATT GGA AGG AAA	240
Glu Arg Gly Asp Phe Pro Gly Thr Tyr Val Glu Tyr Ile Gly Arg Lys	
65 70 75 80	
AAA ATC TCG CCT CCC ACA CCA AAG CCC CGG CCA CCT CGG CCT CTT CCT	288
Lys Ile Ser Pro Pro Thr Pro Lys Pro Arg Pro Pro Arg Pro Leu Pro	
85 90 95	
GTT GCA CCA GGT TCT TCG AAA ACT GAA GCA GAT GTT GAA CAA CAA GCT	336
Val Ala Pro Gly Ser Ser Lys Thr Glu Ala Asp Val Glu Gln Gln Ala	
100 105 110	
TTG ACT CTC CCG GAT CTT GCA GAG CAG TTT GCC CCT CCT GAC ATT GCC	384
Leu Thr Leu Pro Asp Leu Ala Glu Gln Phe Ala Pro Pro Asp Ile Ala	
115 120 125	
CCG CCT CTT CTT ATC AAG CTC GTG GAA GCC ATT GAA AAG AAA GGT CTG	432
Pro Pro Leu Leu Ile Lys Leu Val Glu Ala Ile Glu Lys Lys Gly Leu	
130 135 140	
GAA TGT TCA ACT CTA TAC AGA ACA CAG AGC TCC AGC AAC CTG GCA GAA	480
Glu Cys Ser Thr Leu Tyr Arg Thr Gln Ser Ser Ser Asn Leu Ala Glu	
145 150 155 160	
TTA CGA CAG CTT CTT GAT TGT GAT ACA CCC TCC GTG GAC TTG GAA ATG	528
Leu Arg Gln Leu Leu Asp Cys Asp Thr Pro Ser Val Asp Leu Glu Met	
165 170 175	
ATC GAT GTG CAC GTT TTG GCT GAC GCT TTC AAA CGC TAT CTC CTG GAC	576
Ile Asp Val His Val Leu Ala Asp Ala Phe Lys Arg Tyr Leu Leu Asp	
180 185 190	
TTA CCA AAT CCT GTC ATT CCA GCA GCC GTT TAC AGT GAA ATG ATT TCT	624
Leu Pro Asn Pro Val Ile Pro Ala Ala Val Tyr Ser Glu Met Ile Ser	
195 200 205	
TTA GCT CCA GAA GTA CAA AGC TCC GAA GAA TAT ATT CAG CTA TTG AAG	672

Leu	Ala	Pro	Glu	Val	Gln	Ser	Ser	Glu	Glu	Tyr	Ile	Gln	Leu	Leu	Lys	
210						215					220					
AAG	CTT	ATT	AGG	TCG	CCT	AGC	ATA	CCT	CAT	CAG	TAT	TGG	CTT	ACG	CTT	720
Lys	Leu	Ile	Arg	Ser	Pro	Ser	Ile	Pro	His	Gln	Tyr	Trp	Leu	Thr	Leu	
225					230					235					240	
CAG	TAT	TTG	TTA	AAA	CAT	TTC	TTC	AAG	CTC	TCT	CAA	ACC	TCC	AGC	AAA	768
Gln	Tyr	Leu	Leu	Lys	His	Phe	Phe	Lys	Leu	Ser	Gln	Thr	Ser	Ser	Lys	
				245					250						255	
AAT	CTG	TTG	AAT	GCA	AGA	GTA	CTC	TCT	GAA	ATT	TTC	AGC	CCT	ATG	CTT	816
Asn	Leu	Leu	Asn	Ala	Arg	Val	Leu	Ser	Glu	Ile	Phe	Ser	Pro	Met	Leu	
			260						265					270		
TTC	AGA	TTC	TCA	GCA	GCC	AGC	TCT	GAT	AAT	ACT	GAA	AAC	CTC	ATA	AAA	864
Phe	Arg	Phe	Ser	Ala	Ala	Ser	Ser	Asp	Asn	Thr	Glu	Asn	Leu	Ile	Lys	
			275					280					285			
GTT	ATA	GAA	ATT	TTA	ATC	TCA	ACT	GAA	TGG	AAT	GAA	CGA	CAG	CCT	GCA	912
Val	Ile	Glu	Ile	Leu	Ile	Ser	Thr	Glu	Trp	Asn	Glu	Arg	Gln	Pro	Ala	
						295							300			
CCA	GCA	CTG	CCT	CCT	AAA	CCA	CCA	AAA	CCT	ACT	ACT	GTA	GCC	AAC	AAC	960
Pro	Ala	Leu	Pro	Pro	Lys	Pro	Pro	Lys	Pro	Thr	Thr	Val	Ala	Asn	Asn	
305					310										320	
GGT	ATG	AAT	AAC	AAT	ATG	TCC	TTA	CAA	AAT	GCT	GAA	TGG	TAC	TGG	GGA	1008
Gly	Met	Asn	Asn	Asn	Met	Ser	Leu	Gln	Asn	Ala	Glu	Trp	Tyr	Trp	Gly	
				325					330						335	
GAT	ATC	TCG	AGG	GAA	GAA	GTG	AAT	GAA	AAA	CTT	CGA	GAT	ACA	GCA	GAC	1056
Asp	Ile	Ser	Arg	Glu	Glu	Val	Asn	Glu	Lys	Leu	Arg	Asp	Thr	Ala	Asp	
				340					345					350		
GGG	ACC	TTT	TTG	GTA	CGA	GAT	GCG	TCT	ACT	AAA	ATG	CAT	GGT	GAT	TAT	1104
Gly	Thr	Phe	Leu	Val	Arg	Asp	Ala	Ser	Thr	Lys	Met	His	Gly	Asp	Tyr	
				355					360					365		
ACT	CTT	ACA	CTA	AGG	AAA	GGG	GGA	AAT	AAC	AAA	TTA	ATC	AAA	ATA	TTT	1152
Thr	Leu	Thr	Leu	Arg	Lys	Gly	Gly	Asn	Asn	Lys	Leu	Ile	Lys	Ile	Phe	
				370					375					380		
CAT	CGA	GAT	GGG	AAA	TAT	GGC	TTC	TCT	GAC	CCA	TTA	ACC	TTC	AGT	TCT	1200
His	Arg	Asp	Gly	Lys	Tyr	Gly	Phe	Ser	Asp	Pro	Leu	Thr	Phe	Ser	Ser	
385					390					395					400	
GTG	GTT	GAA	TTA	ATA	AAC	CAC	TAC	CGG	AAT	GAA	TCT	CTA	GCT	CAG	TAT	1248
Val	Val	Glu	Leu	Ile	Asn	His	Tyr	Arg	Asn	Glu	Ser	Leu	Ala	Gln	Tyr	
				405					410					415		
AAT	CCC	AAA	TTG	GAT	GTG	AAA	TTA	CTT	TAT	CCA	GTA	TCC	AAA	TAC	CAA	1296
Asn	Pro	Lys	Leu	Asp	Val	Lys	Leu	Leu	Tyr	Pro	Val	Ser	Lys	Tyr	Gln	
				420					425					430		
CAG	GAT	CAA	GTT	GTC	AAA	GAA	GAT	AAT	ATT	GAA	GCT	GTA	GGG	AAA	AAA	1344
Gln	Asp	Gln	Val	Val	Lys	Glu	Asp	Asn	Ile	Glu	Ala	Val	Gly	Lys	Lys	
				435					440					445		

TTA CAT GAA TAT AAC ACT CAG TTT CAA GAA AAA AGT CGA GAA TAT GAT	1392
Leu His Glu Tyr Asn Thr Gln Phe Gln Glu Lys Ser Arg Glu Tyr Asp	
450 455 460	
AGA TTA TAT GAA GAA TAT ACC CGC ACA TCC CAG GAA ATC CAA ATG AAA	1440
Arg Leu Tyr Glu Glu Tyr Thr Arg Thr Ser Gln Glu Ile Gln Met Lys	
465 470 475 480	
AGG ACA GCT ATT GAA GCA TTT AAT GAA ACC ATA AAA ATA TTT GAA GAA	1488
Arg Thr Ala Ile Glu Ala Phe Asn Glu Thr Ile Lys Ile Phe Glu Glu	
485 490 495	
CAG TGC CAG ACC CAA GAG CGG TAC AGC AAA GAA TAC ATA GAA AAG TTT	1536
Gln Cys Gln Thr Gln Glu Arg Tyr Ser Lys Glu Tyr Ile Glu Lys Phe	
500 505 510	
AAA CGT GAA GGC AAT GAG AAA GAA ATA CAA AGG ATT ATG CAT AAT TAT	1584
Lys Arg Glu Gly Asn Glu Lys Glu Ile Gln Arg Ile Met His Asn Tyr	
515 520 525	
GAT AAG TTG AAG TCT CGA ATC AGT GAA ATT ATT GAC AGT AGA AGA AGA	1632
Asp Lys Leu Lys Ser Arg Ile Ser Glu Ile Ile Asp Ser Arg Arg Arg	
530 535 540	
TTG GAA GAA GAC TTG AAG AAG CAG GCA GCT GAG TAT CGA GAA ATT GAC	1680
Leu Glu Glu Asp Leu Lys Lys Gln Ala Ala Glu Tyr Arg Glu Ile Asp	
545 550 555 560	
AAA CGT ATG AAC AGC ATT AAA CCA GAC CTT ATC CAG CTG AGA AAG ACG	1728
Lys Arg Met Asn Ser Ile Lys Pro Asp Leu Ile Gln Leu Arg Lys Thr	
565 570 575	
AGA GAC CAA TAC TTG ATG TGG TTG ACT CAA AAA GGT GTT CGG CAA AAG	1776
Arg Asp Gln Tyr Leu Met Trp Leu Thr Gln Lys Gly Val Arg Gln Lys	
580 585 590	
AAG TTG AAC GAG TGG TTG GGC AAT GAA AAC ACT GAA GAC CAA TAT TCA	1824
Lys Leu Asn Glu Trp Leu Gly Asn Glu Asn Thr Glu Asp Gln Tyr Ser	
595 600 605	
CTG GTG GAA GAT GAT GAA GAT TTG CCC CAT CAT GAT GAG AAG ACA TGG	1872
Leu Val Glu Asp Asp Glu Asp Leu Pro His His Asp Glu Lys Thr Trp	
610 615 620	
AAT GTT GGA AGC AGC AAC CGA AAC AAA GCT GAA AAC CTG TTG CGA GGG	1920
Asn Val Gly Ser Ser Asn Arg Asn Lys Ala Glu Asn Leu Leu Arg Gly	
625 630 635 640	
AAG CGA GAT GGC ACT TTT CTT GTC CGG GAG AGC AGT AAA CAG GGC TGC	1968
Lys Arg Asp Gly Thr Phe Leu Val Arg Glu Ser Ser Lys Gln Gly Cys	
645 650 655	
TAT GCC TGC TCT GTA GTG GTG GAC GGC GAA GTA AAG CAT TGT GTC ATA	2016
Tyr Ala Cys Ser Val Val Val Asp Gly Glu Val Lys His Cys Val Ile	
660 665 670	
AAC AAA ACA GCA ACT GGC TAT GGC TTT GCC GAG CCC TAT AAC TTG TAC	2064

Asn Lys Thr Ala Thr Gly Tyr Gly Phe Ala Glu Pro Tyr Asn Leu Tyr	
675 680 685	
AGC TCT CTG AAA GAA CTG GTG CTA CAT TAC CAA CAC ACC TCC CTT GTG	2112
Ser Ser Leu Lys Glu Leu Val Leu His Tyr Gln His Thr Ser Leu Val	
690 695 700	
CAG CAC AAC GAC TCC CTC AAT GTC ACA CTA GCC TAC CCA GTA TAT GCA	2160
Gln His Asn Asp Ser Leu Asn Val Thr Leu Ala Tyr Pro Val Tyr Ala	
705 710 715 720	
CAG CAG AGG CGA CAG GAT CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC	2208
Gln Gln Arg Arg Gln Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly	
725 730 735	
GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC	2256
Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly	
740 745 750	
GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT	2304
Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp	
755 760 765	
GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG	2352
Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys	
770 775 780	
CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG	2400
Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val	
785 790 795 800	
CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC	2448
Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe	
805 810 815	
AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC	2496
Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe	
820 825 830	
AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC	2544
Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly	
835 840 845	
GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG	2592
Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu	
850 855 860	
GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC	2640
Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His	
865 870 875 880	
AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC	2688
Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn	
885 890 895	
TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC	2736
Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp	
900 905 910	

CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC	2784
His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro	
915 920 925	
GAG AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC	2832
Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn	
930 935 940	
GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG	2880
Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly	
945 950 955 960	
ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA	2913
Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys	
965 970	

## (2) INFORMATION FOR SEQ ID NO:67:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 970 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:67:

Met	Ser	Ala	Glu	Gly	Tyr	Gln	Tyr	Arg	Ala	Leu	Tyr	Asp	Tyr	Lys	Lys
1				5					10					15	
Glu	Arg	Glu	Glu	Asp	Ile	Asp	Leu	His	Leu	Gly	Asp	Ile	Leu	Thr	Val
		20					25					30			
Asn	Lys	Gly	Ser	Leu	Val	Ala	Leu	Gly	Phe	Ser	Asp	Gly	Gln	Glu	Ala
		35				40					45				
Arg	Pro	Glu	Glu	Ile	Gly	Trp	Leu	Asn	Gly	Tyr	Asn	Glu	Thr	Thr	Gly
	50				55					60					
Glu	Arg	Gly	Asp	Phe	Pro	Gly	Thr	Tyr	Val	Glu	Tyr	Ile	Gly	Arg	Lys
65				70					75					80	
Lys	Ile	Ser	Pro	Pro	Thr	Pro	Lys	Pro	Arg	Pro	Pro	Arg	Pro	Leu	Pro
			85					90						95	
Val	Ala	Pro	Gly	Ser	Ser	Lys	Thr	Glu	Ala	Asp	Val	Glu	Gln	Gln	Ala
		100						105					110		
Leu	Thr	Leu	Pro	Asp	Leu	Ala	Glu	Gln	Phe	Ala	Pro	Pro	Asp	Ile	Ala
		115				120					125				
Pro	Pro	Leu	Leu	Ile	Lys	Leu	Val	Glu	Ala	Ile	Glu	Lys	Lys	Gly	Leu
	130				135						140				
Glu	Cys	Ser	Thr	Leu	Tyr	Arg	Thr	Gln	Ser	Ser	Ser	Asn	Leu	Ala	Glu
145				150						155					160
Leu	Arg	Gln	Leu	Leu	Asp	Cys	Asp	Thr	Pro	Ser	Val	Asp	Leu	Glu	Met
		165						170					175		
Ile	Asp	Val	His	Val	Leu	Ala	Asp	Ala	Phe	Lys	Arg	Tyr	Leu	Leu	Asp
		180					185						190		
Leu	Pro	Asn	Pro	Val	Ile	Pro	Ala	Ala	Val	Tyr	Ser	Glu	Met	Ile	Ser
		195				200						205			
Leu	Ala	Pro	Glu	Val	Gln	Ser	Ser	Glu	Glu	Tyr	Ile	Gln	Leu	Leu	Lys



210	215	220
Lys Leu Ile Arg Ser Pro	Ser Ile Pro His Gln Tyr Trp Leu Thr Leu	
225	230	235
Gln Tyr Leu Leu Lys His Phe Phe Lys Leu Ser Gln Thr Ser Ser Lys		240
	245	250
Asn Leu Leu Asn Ala Arg Val Leu Ser Glu Ile Phe Ser Pro Met Leu		255
	260	265
Phe Arg Phe Ser Ala Ala Ser Ser Asp Asn Thr Glu Asn Leu Ile Lys		270
	275	280
Val Ile Glu Ile Leu Ile Ser Thr Glu Trp Asn Glu Arg Gln Pro Ala		285
	290	295
Pro Ala Leu Pro Pro Lys Pro Pro Lys Pro Thr Thr Val Ala Asn Asn		300
305	310	315
Gly Met Asn Asn Asn Met Ser Leu Gln Asn Ala Glu Trp Tyr Trp Gly		320
	325	330
Asp Ile Ser Arg Glu Glu Val Asn Glu Lys Leu Arg Asp Thr Ala Asp		335
	340	345
Gly Thr Phe Leu Val Arg Asp Ala Ser Thr Lys Met His Gly Asp Tyr		350
	355	360
Thr Leu Thr Leu Arg Lys Gly Gly Asn Asn Lys Leu Ile Lys Ile Phe		365
	370	375
His Arg Asp Gly Lys Tyr Gly Phe Ser Asp Pro Leu Thr Phe Ser Ser		380
385	390	395
Val Val Glu Leu Ile Asn His Tyr Arg Asn Glu Ser Leu Ala Gln Tyr		400
	405	410
Asn Pro Lys Leu Asp Val Lys Leu Leu Tyr Pro Val Ser Lys Tyr Gln		415
	420	425
Gln Asp Gln Val Val Lys Glu Asp Asn Ile Glu Ala Val Gly Lys Lys		430
	435	440
Leu His Glu Tyr Asn Thr Gln Phe Gln Glu Lys Ser Arg Glu Tyr Asp		445
	450	455
Arg Leu Tyr Glu Glu Tyr Thr Arg Thr Ser Gln Glu Ile Gln Met Lys		460
465	470	475
Arg Thr Ala Ile Glu Ala Phe Asn Glu Thr Ile Lys Ile Phe Glu Glu		480
	485	490
Gln Cys Gln Thr Gln Glu Arg Tyr Ser Lys Glu Tyr Ile Glu Lys Phe		495
	500	505
Lys Arg Glu Gly Asn Glu Lys Glu Ile Gln Arg Ile Met His Asn Tyr		510
	515	520
Asp Lys Leu Lys Ser Arg Ile Ser Glu Ile Ile Asp Ser Arg Arg Arg		525
	530	535
Leu Glu Glu Asp Leu Lys Lys Gln Ala Ala Glu Tyr Arg Glu Ile Asp		540
545	550	555
Lys Arg Met Asn Ser Ile Lys Pro Asp Leu Ile Gln Leu Arg Lys Thr		560
	565	570
Arg Asp Gln Tyr Leu Met Trp Leu Thr Gln Lys Gly Val Arg Gln Lys		575
	580	585
Lys Leu Asn Glu Trp Leu Gly Asn Glu Asn Thr Glu Asp Gln Tyr Ser		590
	595	600
Leu Val Glu Asp Asp Glu Asp Leu Pro His His Asp Glu Lys Thr Trp		605
	610	615
Asn Val Gly Ser Ser Asn Arg Asn Lys Ala Glu Asn Leu Leu Arg Gly		620
625	630	635
Lys Arg Asp Gly Thr Phe Leu Val Arg Glu Ser Ser Lys Gln Gly Cys		640
	645	650
Tyr Ala Cys Ser Val Val Val Asp Gly Glu Val Lys His Cys Val Ile		655
	660	665
Asn Lys Thr Ala Thr Gly Tyr Gly Phe Ala Glu Pro Tyr Asn Leu Tyr		670

675					680					685					
Ser	Ser	Leu	Lys	Glu	Leu	Val	Leu	His	Tyr	Gln	His	Thr	Ser	Leu	Val
690					695					700					
Gln	His	Asn	Asp	Ser	Leu	Asn	Val	Thr	Leu	Ala	Tyr	Pro	Val	Tyr	Ala
705					710					715					
Gln	Gln	Arg	Arg	Gln	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly
720					725					730					
Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly
735					740					745					
Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp
750					755					760					
Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys
765					770					775					
Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val
780					785					790					
Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	Phe
800					805					810					
Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg	Thr	Ile	Phe	Phe
815					820					825					
Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	Val	Lys	Phe	Glu	Gly
830					835					840					
Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	Ile	Asp	Phe	Lys	Glu
845					850					855					
Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	Asn	Tyr	Asn	Ser	His
860					865					870					
Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	Gly	Ile	Lys	Val	Asn
875					880					885					
Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	Val	Gln	Leu	Ala	Asp
890					900					905					
His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	Pro	Val	Leu	Leu	Pro
910					915					920					
Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	Ser	Lys	Asp	Pro	Asn
925					930					935					
Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	Val	Thr	Ala	Ala	Gly
940					945					950					
Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys						
955					960					965					
965					970										

(2) INFORMATION FOR SEQ ID NO:68:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1788 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...1785  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:68:

ATG GGC AAC GCC GCC GCC GCC AAG AAG GGC AGC GAG CAG GAG AGC GTG  
Met Gly Asn Ala Ala Ala Ala Lys Lys Gly Ser Glu Gln Glu Ser Val  
1 5 10 15

AAA GAG TTC CTA GCC AAA GCC AAG GAA GAT TTC CTG AAA AAA TGG GAA Lys Glu Phe Leu Ala Lys Ala Lys Glu Asp Phe Leu Lys Lys Trp Glu	96
20 25 30	
GAC CCC TCT CAG AAT ACA GCC CAG TTG GAT CAG TTT GAT AGA ATC AAG Asp Pro Ser Gln Asn Thr Ala Gln Leu Asp Gln Phe Asp Arg Ile Lys	144
35 40 45	
ACC CTT GGC ACC GGC TCC TTT GGG CGA GTG ATG CTG GTG AAG CAC AAG Thr Leu Gly Thr Gly Ser Phe Gly Arg Val Met Leu Val Lys His Lys	192
50 55 60	
GAG AGT GGG AAC CAC TAC GCC ATG AAG ATC TTA GAC AAG CAG AAG GTG Glu Ser Gly Asn His Tyr Ala Met Lys Ile Leu Asp Lys Gln Lys Val	240
65 70 75 80	
GTG AAG CTA AAG CAG ATC GAG CAC ACT CTG AAT GAG AAG CGC ATC CTG Val Lys Leu Lys Gln Ile Glu His Thr Leu Asn Glu Lys Arg Ile Leu	288
85 90 95	
CAG GCC GTC AAC TTC CCG TTC CTG GTC AAA CTT GAA TTC TCC TTC AAG Gln Ala Val Asn Phe Pro Phe Leu Val Lys Leu Glu Phe Ser Phe Lys	336
100 105 110	
GAC AAC TCA AAC CTG TAC ATG GTC ATG GAG TAT GTA GCT GGT GGC GAG Asp Asn Ser Asn Leu Tyr Met Val Met Glu Tyr Val Ala Gly Gly Glu	384
115 120 125	
ATG TTC TCC CAC CTA CGG CGG ATT GGA AGG TTC AGC GAG CCC CAT GCC Met Phe Ser His Leu Arg Arg Ile Gly Arg Phe Ser Glu Pro His Ala	432
130 135 140	
CGT TTC TAC GCG GCG CAG ATC GTC CTG ACC TTT GAG TAT CTG CAC TCC Arg Phe Tyr Ala Ala Gln Ile Val Leu Thr Phe Glu Tyr Leu His Ser	480
145 150 155 160	
CTG GAC CTC ATC TAC CGG GAC CTG AAG CCC GAG AAT CTT CTC ATC GAC Leu Asp Leu Ile Tyr Arg Asp Leu Lys Pro Glu Asn Leu Leu Ile Asp	528
165 170 175	
CAG CAG GGC TAT ATT CAG GTG ACA GAC TTC GGT TTT GCC AAG CGT GTG Gln Gln Gly Tyr Ile Gln Val Thr Asp Phe Gly Phe Ala Lys Arg Val	576
180 185 190	
AAA GGC CGT ACT TGG ACC TTG TGT GGG ACC CCT GAG TAC TTG GCC CCC Lys Gly Arg Thr Trp Thr Leu Cys Gly Thr Pro Glu Tyr Leu Ala Pro	624
195 200 205	
GAG ATT ATC CTG AGC AAA GGC TAC AAC AAG GCT GTG GAC TGG TGG GCT Glu Ile Ile Leu Ser Lys Gly Tyr Asn Lys Ala Val Asp Trp Trp Ala	672
210 215 220	
CTC GGA GTC CTC ATC TAC GAG ATG GCT GCT GGT TAC CCA CCC TTC TTC Leu Gly Val Leu Ile Tyr Glu Met Ala Ala Gly Tyr Pro Pro Phe Phe	720
225 230 235 240	
GCT GAC CAG CCT ATC CAG ATC TAT GAG AAA ATC GTC TCT GGG AAG GTG	768

Ala	Asp	Gln	Pro	Ile	Gln	Ile	Tyr	Glu	Lys	Ile	Val	Ser	Gly	Lys	Val	
				245					250					255		
CGG	TTC	CCA	TCC	CAC	TTC	AGC	TCT	GAC	TTG	AAG	GAC	CTG	CTG	CGG	AAC	816
Arg	Phe	Pro	Ser	His	Phe	Ser	Ser	Asp	Leu	Lys	Asp	Leu	Leu	Arg	Asn	
			260					265					270			
CTT	CTG	CAA	GTG	GAT	CTA	ACC	AAG	CGC	TTT	GGA	AAC	CTC	AAG	GAC	GGG	864
Leu	Leu	Gln	Val	Asp	Leu	Thr	Lys	Arg	Phe	Gly	Asn	Leu	Lys	Asp	Gly	
		275					280					285				
GTC	AAT	GAC	ATC	AAG	AAC	CAC	AAG	TGG	TTT	GCC	ACG	ACT	GAC	TGG	ATT	912
Val	Asn	Asp	Ile	Lys	Asn	His	Lys	Trp	Phe	Ala	Thr	Thr	Asp	Trp	Ile	
	290					295					300					
GCC	ATC	TAT	CAG	AGA	AAG	GTG	GAA	GCT	CCC	TTC	ATA	CCA	AAG	TTT	AAA	960
Ala	Ile	Tyr	Gln	Arg	Lys	Val	Glu	Ala	Pro	Phe	Ile	Pro	Lys	Phe	Lys	
305					310					315					320	
GGC	CCT	GGG	GAC	ACG	AGT	AAC	TTT	GAC	GAC	TAT	GAG	GAG	GAA	GAG	ATC	1008
Gly	Pro	Gly	Asp	Thr	Ser	Asn	Phe	Asp	Asp	Tyr	Glu	Glu	Glu	Glu	Ile	
				325					330					335		
CGG	GTC	TCC	ATC	AAT	GAG	AAG	TGT	GGC	AAG	GAG	TTT	ACT	GAG	TTT	GGG	1056
Arg	Val	Ser	Ile	Asn	Glu	Lys	Cys	Gly	Lys	Glu	Phe	Thr	Glu	Phe	Gly	
			340					345						350		
CGC	GCC	ATG	AGT	AAA	GGA	GAA	GAA	CTT	TTC	ACT	GGA	GTT	GTC	CCA	ATT	1104
Arg	Ala	Met	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	
		355						360					365			
CTT	GTT	GAA	TTA	GAT	GGC	GAT	GTT	AAT	GGG	CAA	AAA	TTC	TCT	GTT	AGT	1152
Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	Gln	Lys	Phe	Ser	Val	Ser	
	370					375					380					
GGA	GAG	GGT	GAA	GGT	GAT	GCA	ACA	TAC	GGA	AAA	CTT	ACC	CTT	AAA	TTT	1200
Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	
385					390					395					400	
ATT	TGC	ACT	ACT	GGG	AAG	CTA	CCT	GTT	CCA	TGG	CCA	ACG	CTT	GTC	ACT	1248
Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	
				405					410					415		
ACT	CTC	ACT	TAT	GGT	GTT	CAA	TGC	TTT	TCT	AGA	TAC	CCA	GAT	CAT	ATG	1296
Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	
			420					425						430		
AAA	CAG	CAT	GAC	TTT	TTC	AAG	AGT	GCC	ATG	CCC	GAA	GGT	TAT	GTA	CAG	1344
Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	
		435					440					445				
GAA	AGA	ACT	ATA	TTT	TAC	AAA	GAT	GAC	GGG	AAC	TAC	AAG	ACA	CGT	GCT	1392
Glu	Arg	Thr	Ile	Phe	Tyr	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	
	450					455					460					
GAA	GTC	AAG	TTT	GAA	GGT	GAT	ACC	CTT	GTT	AAT	AGA	ATC	GAG	TTA	AAA	1440
Glu	Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	
465					470					475					480	

GGT ATT GAT TTT AAA GAA GAT GGA AAC ATT CTT GGA CAC AAA ATG GAA 1488  
 Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Met Glu  
                     485                    490                    495

TAC AAT TAT AAC TCA CAT AAT GTA TAC ATC ATG GCA GAC AAA CCA AAG 1536  
 Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Pro Lys  
                     500                    505                    510

AAT GGC ATC AAA GTT AAC TTC AAA ATT AGA CAC AAC ATT AAA GAT GGA 1584  
 Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Lys Asp Gly  
                     515                    520                    525

AGC GTT CAA TTA GCA GAC CAT TAT CAA CAA AAT ACT CCA ATT GGC GAT 1632  
 Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp  
                     530                    535                    540

GGC CCT GTC CTT TTA CCA GAC AAC CAT TAC CTG TCC ACG CAA TCT GCC 1680  
 Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala  
                     545                    550                    555                    560

CTT TCC AAA GAT CCC AAC GAA AAG AGA GAT CAC ATG ATC CTT CTT GAG 1728  
 Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Ile Leu Leu Glu  
                     565                    570                    575

TTT GTA ACA GCT GCT GGG ATT ACA CAT GGC ATG GAT GAA CTA TAC AAA 1776  
 Phe Val Thr Ala Ala Gly Ile Thr His Gly Met Asp Glu Leu Tyr Lys  
                     580                    585                    590

CCT CAG GAG TAA 1788  
 Pro Gln Glu  
                     595

## (2) INFORMATION FOR SEQ ID NO:69:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 595 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:69:

Met Gly Asn Ala Ala Ala Lys Lys Gly Ser Glu Gln Glu Ser Val  
 1                    5                    10                    15  
 Lys Glu Phe Leu Ala Lys Ala Lys Glu Asp Phe Leu Lys Lys Trp Glu  
                     20                    25                    30  
 Asp Pro Ser Gln Asn Thr Ala Gln Leu Asp Gln Phe Asp Arg Ile Lys  
                     35                    40                    45  
 Thr Leu Gly Thr Gly Ser Phe Gly Arg Val Met Leu Val Lys His Lys  
                     50                    55                    60  
 Glu Ser Gly Asn His Tyr Ala Met Lys Ile Leu Asp Lys Gln Lys Val  
                     65                    70                    75                    80  
 Val Lys Leu Lys Gln Ile Glu His Thr Leu Asn Glu Lys Arg Ile Leu

										85					90					95					
Gln	Ala	Val	Asn	Phe	Pro	Phe	Leu	Val	Lys	Leu	Glu	Phe	Ser	Phe	Lys										
										100					105					110					
Asp	Asn	Ser	Asn	Leu	Tyr	Met	Val	Met	Glu	Tyr	Val	Ala	Gly	Gly	Glu										
										115					120					125					
Met	Phe	Ser	His	Leu	Arg	Arg	Ile	Gly	Arg	Phe	Ser	Glu	Pro	His	Ala										
										130					135					140					
Arg	Phe	Tyr	Ala	Ala	Gln	Ile	Val	Leu	Thr	Phe	Glu	Tyr	Leu	His	Ser										
										145					150					155					
Leu	Asp	Leu	Ile	Tyr	Arg	Asp	Leu	Lys	Pro	Glu	Asn	Leu	Leu	Ile	Asp										
										165					170					175					
Gln	Gln	Gly	Tyr	Ile	Gln	Val	Thr	Asp	Phe	Gly	Phe	Ala	Lys	Arg	Val										
										180					185					190					
Lys	Gly	Arg	Thr	Trp	Thr	Leu	Cys	Gly	Thr	Pro	Glu	Tyr	Leu	Ala	Pro										
										195					200					205					
Glu	Ile	Ile	Leu	Ser	Lys	Gly	Tyr	Asn	Lys	Ala	Val	Asp	Trp	Trp	Ala										
										210					215					220					
Leu	Gly	Val	Leu	Ile	Tyr	Glu	Met	Ala	Ala	Gly	Tyr	Pro	Pro	Phe	Phe										
										225					230					235					
Ala	Asp	Gln	Pro	Ile	Gln	Ile	Tyr	Glu	Lys	Ile	Val	Ser	Gly	Lys	Val										
										245					250					255					
Arg	Phe	Pro	Ser	His	Phe	Ser	Ser	Asp	Leu	Lys	Asp	Leu	Leu	Arg	Asn										
										260					265					270					
Leu	Leu	Gln	Val	Asp	Leu	Thr	Lys	Arg	Phe	Gly	Asn	Leu	Lys	Asp	Gly										
										275					280					285					
Val	Asn	Asp	Ile	Lys	Asn	His	Lys	Trp	Phe	Ala	Thr	Thr	Asp	Trp	Ile										
										290					295					300					
Ala	Ile	Tyr	Gln	Arg	Lys	Val	Glu	Ala	Pro	Phe	Ile	Pro	Lys	Phe	Lys										
										305					310					315					
Gly	Pro	Gly	Asp	Thr	Ser	Asn	Phe	Asp	Asp	Tyr	Glu	Glu	Glu	Glu	Ile										
										325					330					335					
Arg	Val	Ser	Ile	Asn	Glu	Lys	Cys	Gly	Lys	Glu	Phe	Thr	Glu	Phe	Gly										
										340					345					350					
Arg	Ala	Met	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile										
										355					360					365					
Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	Gln	Lys	Phe	Ser	Val	Ser										
										370					375					380					
Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe										
										385					390					395					
Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr										
										405					410					415					
Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met										
										420					425					430					
Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln										
										435					440					445					
Glu	Arg	Thr	Ile	Phe	Tyr	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala										
										450					455					460					
Glu	Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys										
										465					470					475					
Gly	Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Met	Glu										
										485					490					495					
Tyr	Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Pro	Lys										
										500					505					510					
Asn	Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Lys	Asp	Gly										
										515					520					525					
Ser	Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp										
										530					535					540					
Gly	Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala										

545                      550                      555                      560  
 Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Ile Leu Leu Glu  
                                  565                      570                      575  
 Phe Val Thr Ala Ala Gly Ile Thr His Gly Met Asp Glu Leu Tyr Lys  
                                  580                      585                      590  
 Pro Gln Glu  
                                  595

(2) INFORMATION FOR SEQ ID NO:70:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2181 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2178
- (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:70:

ATG AGC GAC GTG GCT ATT GTG AAG GAG GGT TGG CTG CAC AAA CGA GGG	48
Met Ser Asp Val Ala Ile Val Lys Glu Gly Trp Leu His Lys Arg Gly	
1                                      5                                      10                                      15	
GAG TAC ATC AAG ACC TGG CGG CCA CGC TAC TTC CTC CTC AAG AAT GAT	96
Glu Tyr Ile Lys Thr Trp Arg Pro Arg Tyr Phe Leu Leu Lys Asn Asp	
20                                      25                                      30	
GGC ACC TTC ATT GGC TAC AAG GAG CGG CCG CAG GAT GTG GAC CAA CGT	144
Gly Thr Phe Ile Gly Tyr Lys Glu Arg Pro Gln Asp Val Asp Gln Arg	
35                                      40                                      45	
GAG GCT CCC CTC AAC AAC TTC TCT GTG GCG CAG TGC CAG CTG ATG AAG	192
Glu Ala Pro Leu Asn Asn Phe Ser Val Ala Gln Cys Gln Leu Met Lys	
50                                      55                                      60	
ACG GAG CGG CCC CGG CCC AAC ACC TTC ATC ATC CGC TGC CTG CAG TGG	240
Thr Glu Arg Pro Arg Pro Asn Thr Phe Ile Ile Arg Cys Leu Gln Trp	
65                                      70                                      75                                      80	
ACC ACT GTC ATC GAA CGC ACC TTC CAT GTG GAG ACT CCT GAG GAG CGG	288
Thr Thr Val Ile Glu Arg Thr Phe His Val Glu Thr Pro Glu Glu Arg	
85                                      90                                      95	
GAG GAG TGG ACA ACC GCC ATC CAG ACT GTG GCT GAC GGC CTC AAG AAG	336
Glu Glu Trp Thr Thr Ala Ile Gln Thr Val Ala Asp Gly Leu Lys Lys	
100                                      105                                      110	
CAG GAG GAG GAG GAG ATG GAC TTC CGG TCG GGC TCA CCC AGT GAC AAC	384
Gln Glu Glu Glu Glu Met Asp Phe Arg Ser Gly Ser Pro Ser Asp Asn	
115                                      120                                      125	
TCA GGG GCT GAA GAG ATG GAG GTG TCC CTG GCC AAG CCC AAG CAC CGC	432

Ser Gly Ala Glu Glu Met Glu Val Ser Leu Ala Lys Pro Lys His Arg	
130 135 140	
GTG ACC ATG AAC GAG TTT GAG TAC CTG AAG CTG CTG GGC AAG GGC ACT	480
Val Thr Met Asn Glu Phe Glu Tyr Leu Lys Leu Leu Gly Lys Gly Thr	
145 150 155 160	
TTC GGC AAG GTG ATC CTG GTG AAG GAG AAG GCC ACA GGC CGC TAC TAC	528
Phe Gly Lys Val Ile Leu Val Lys Glu Lys Ala Thr Gly Arg Tyr Tyr	
165 170 175	
GCC ATG AAG ATC CTC AAG AAG GAA GTC ATC GTG GCC AAG GAC GAG GTG	576
Ala Met Lys Ile Leu Lys Lys Glu Val Ile Val Ala Lys Asp Glu Val	
180 185 190	
GCC CAC ACA CTC ACC GAG AAC CGC GTC CTG CAG AAC TCC AGG CAC CCC	624
Ala His Thr Leu Thr Glu Asn Arg Val Leu Gln Asn Ser Arg His Pro	
195 200 205	
TTC CTC ACA GCC CTG AAG TAC TCT TTC CAG ACC CAC GAC CGC CTC TGC	672
Phe Leu Thr Ala Leu Lys Tyr Ser Phe Gln Thr His Asp Arg Leu Cys	
210 215 220	
TTT GTC ATG GAG TAC GCC AAC GGG GGC GAG CTG TTC TTC CAC CTG TCC	720
Phe Val Met Glu Tyr Ala Asn Gly Gly Glu Leu Phe Phe His Leu Ser	
225 230 235 240	
CGG GAA CGT GTG TTC TCC GAG GAC CGG GCC CGC TTC TAT GGC GCT GAG	768
Arg Glu Arg Val Phe Ser Glu Asp Arg Ala Arg Phe Tyr Gly Ala Glu	
245 250 255	
ATT GTG TCA GCC CTG GAC TAC CTG CAC TCG GAG AAG AAC GTG GTG TAC	816
Ile Val Ser Ala Leu Asp Tyr Leu His Ser Glu Lys Asn Val Val Tyr	
260 265 270	
CGG GAC CTC AAG CTG GAG AAC CTC ATG CTG GAC AAG GAC GGG CAC ATT	864
Arg Asp Leu Lys Leu Glu Asn Leu Met Leu Asp Lys Asp Gly His Ile	
275 280 285	
AAG ATC ACA GAC TTC GGG CTG TGC AAG GAG GGG ATC AAG GAC GGT GCC	912
Lys Ile Thr Asp Phe Gly Leu Cys Lys Glu Gly Ile Lys Asp Gly Ala	
290 295 300	
ACC ATG AAG ACC TTT TGC GGC ACA CCT GAG TAC CTG GCC CCC GAG GTG	960
Thr Met Lys Thr Phe Cys Gly Thr Pro Glu Tyr Leu Ala Pro Glu Val	
305 310 315 320	
CTG GAG GAC AAT GAC TAC GGC CGT GCA GTG GAC TGG TGG GGG CTG GGC	1008
Leu Glu Asp Asn Asp Tyr Gly Arg Ala Val Asp Trp Trp Gly Leu Gly	
325 330 335	
GTG GTC ATG TAC GAG ATG ATG TGC GGT CGC CTG CCC TTC TAC AAC CAG	1056
Val Val Met Tyr Glu Met Met Cys Gly Arg Leu Pro Phe Tyr Asn Gln	
340 345 350	
GAC CAT GAG AAG CTT TTT GAG CTC ATC CTC ATG GAG GAG ATC CGC TTC	1104
Asp His Glu Lys Leu Phe Glu Leu Ile Leu Met Glu Glu Ile Arg Phe	
355 360 365	



CCG CGC ACG CTT GGT CCC GAG GCC AAG TCC TTG CTT TCA GGG CTG CTC	1152
Pro Arg Thr Leu Gly Pro Glu Ala Lys Ser Leu Leu Ser Gly Leu Leu	
370 375 380	
AAG AAG GAC CCC AAG CAG AGG CTT GGC GGG GGC TCC GAG GAC GCC AAG	1200
Lys Lys Asp Pro Lys Gln Arg Leu Gly Gly Gly Ser Glu Asp Ala Lys	
385 390 395 400	
GAG ATC ATG CAG CAT CGC TTC TTT GCC GGT ATC GTG TGG CAG CAC GTG	1248
Glu Ile Met Gln His Arg Phe Phe Ala Gly Ile Val Trp Gln His Val	
405 410 415	
TAC GAG AAG AAG CTC AGC CCA CCC TTC AAG CCC CAG GTC ACG TCG GAG	1296
Tyr Glu Lys Lys Leu Ser Pro Pro Phe Lys Pro Gln Val Thr Ser Glu	
420 425 430	
ACT GAC ACC AGG TAT TTT GAT GAG GAG TTC ACG GCC CAG ATG ATC ACC	1344
Thr Asp Thr Arg Tyr Phe Asp Glu Glu Phe Thr Ala Gln Met Ile Thr	
435 440 445	
ATC ACA CCA CCT GAC CAA GAT GAC AGC ATG GAG TGT GTG GAC AGC GAG	1392
Ile Thr Pro Pro Asp Gln Asp Asp Ser Met Glu Cys Val Asp Ser Glu	
450 455 460	
CGC AGG CCC CAC TTC CCC CAG TTC TCC TAC TCG GCC AGC AGC ACG GCC	1440
Arg Arg Pro His Phe Pro Gln Phe Ser Tyr Ser Ala Ser Ser Thr Ala	
465 470 475 480	
TCG GAT CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC GAG GAG CTG TTC	1488
Ser Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe	
485 490 495	
ACC GGG GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC GAC GTA AAC GGC	1536
Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly	
500 505 510	
CAC AAG TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT GCC ACC TAC GGC	1584
His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly	
515 520 525	
AAG CTG ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG CCC	1632
Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro	
530 535 540	
TGG CCC ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC AGC	1680
Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser	
545 550 555 560	
CGC TAC CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG	1728
Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met	
565 570 575	
CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC	1776
Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly	
580 585 590	
AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG	1824

Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val	
595 600 605	
AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC	1872
Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile	
610 615 620	
CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC	1920
Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile	
625 630 635 640	
ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC	1968
Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg	
645 650 655	
CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG	2016
His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln	
660 665 670	
AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC	2064
Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr	
675 680 685	
CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT	2112
Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp	
690 695 700	
CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC	2160
His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly	
705 710 715 720	
ATG GAC GAG CTG TAC AAG TAA	2181
Met Asp Glu Leu Tyr Lys	
725	

## (2) INFORMATION FOR SEQ ID NO:71:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 726 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:71:

Met Ser Asp Val Ala Ile Val Lys Glu Gly Trp Leu His Lys Arg Gly	
1 5 10 15	
Glu Tyr Ile Lys Thr Trp Arg Pro Arg Tyr Phe Leu Leu Lys Asn Asp	
20 25 30	
Gly Thr Phe Ile Gly Tyr Lys Glu Arg Pro Gln Asp Val Asp Gln Arg	
35 40 45	
Glu Ala Pro Leu Asn Asn Phe Ser Val Ala Gln Cys Gln Leu Met Lys	
50 55 60	
Thr Glu Arg Pro Arg Pro Asn Thr Phe Ile Ile Arg Cys Leu Gln Trp	

65					70					75				80
Thr	Thr	Val	Ile	Glu	Arg	Thr	Phe	His	Val	Glu	Thr	Pro	Glu	Arg
			85						90				95	
Glu	Glu	Trp	Thr	Thr	Ala	Ile	Gln	Thr	Val	Ala	Asp	Gly	Leu	Lys
		100						105					110	
Gln	Glu	Glu	Glu	Glu	Met	Asp	Phe	Arg	Ser	Gly	Ser	Pro	Ser	Asp
		115				120					125			
Ser	Gly	Ala	Glu	Glu	Met	Glu	Val	Ser	Leu	Ala	Lys	Pro	Lys	His
	130					135					140			Arg
Val	Thr	Met	Asn	Glu	Phe	Glu	Tyr	Leu	Lys	Leu	Leu	Gly	Lys	Gly
145				150						155				160
Phe	Gly	Lys	Val	Ile	Leu	Val	Lys	Glu	Lys	Ala	Thr	Gly	Arg	Tyr
			165					170					175	
Ala	Met	Lys	Ile	Leu	Lys	Lys	Glu	Val	Ile	Val	Ala	Lys	Asp	Glu
		180						185					190	Val
Ala	His	Thr	Leu	Thr	Glu	Asn	Arg	Val	Leu	Gln	Asn	Ser	Arg	His
	195					200						205		Pro
Phe	Leu	Thr	Ala	Leu	Lys	Tyr	Ser	Phe	Gln	Thr	His	Asp	Arg	Leu
210					215						220			Cys
Phe	Val	Met	Glu	Tyr	Ala	Asn	Gly	Gly	Glu	Leu	Phe	Phe	His	Leu
225					230				235					240
Arg	Glu	Arg	Val	Phe	Ser	Glu	Asp	Arg	Ala	Arg	Phe	Tyr	Gly	Ala
			245						250				255	Glu
Ile	Val	Ser	Ala	Leu	Asp	Tyr	Leu	His	Ser	Glu	Lys	Asn	Val	Val
		260						265					270	Tyr
Arg	Asp	Leu	Lys	Leu	Glu	Asn	Leu	Met	Leu	Asp	Lys	Asp	Gly	His
	275					280						285		Ile
Lys	Ile	Thr	Asp	Phe	Gly	Leu	Cys	Lys	Glu	Gly	Ile	Lys	Asp	Gly
290					295						300			Ala
Thr	Met	Lys	Thr	Phe	Cys	Gly	Thr	Pro	Glu	Tyr	Leu	Ala	Pro	Glu
305					310				315					Val
Leu	Glu	Asp	Asn	Asp	Tyr	Gly	Arg	Ala	Val	Asp	Trp	Trp	Gly	Leu
			325						330				335	Gly
Val	Val	Met	Tyr	Glu	Met	Met	Cys	Gly	Arg	Leu	Pro	Phe	Tyr	Asn
		340						345					350	Gln
Asp	His	Glu	Lys	Leu	Phe	Glu	Leu	Ile	Leu	Met	Glu	Glu	Ile	Arg
	355					360					365			Phe
Pro	Arg	Thr	Leu	Gly	Pro	Glu	Ala	Lys	Ser	Leu	Leu	Ser	Gly	Leu
370					375					380				Leu
Lys	Lys	Asp	Pro	Lys	Gln	Arg	Leu	Gly	Gly	Gly	Ser	Glu	Asp	Ala
385					390					395				Lys
Glu	Ile	Met	Gln	His	Arg	Phe	Phe	Ala	Gly	Ile	Val	Trp	Gln	His
			405						410				415	Val
Tyr	Glu	Lys	Lys	Leu	Ser	Pro	Pro	Phe	Lys	Pro	Gln	Val	Thr	Ser
		420						425				430		Glu
Thr	Asp	Thr	Arg	Tyr	Phe	Asp	Glu	Glu	Phe	Thr	Ala	Gln	Met	Ile
		435					440					445		Thr
Ile	Thr	Pro	Pro	Asp	Gln	Asp	Asp	Ser	Met	Glu	Cys	Val	Asp	Ser
	450					455					460			Glu
Arg	Arg	Pro	His	Phe	Pro	Gln	Phe	Ser	Tyr	Ser	Ala	Ser	Ser	Thr
465					470					475				Ala
Ser	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu
			485						490				495	Phe
Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn
		500						505				510		Gly
His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr
		515					520				525			Gly
Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Pro

530		535		540	
Trp	Pro	Thr	Leu	Val	Thr
545		550		555	
Arg	Tyr	Pro	Asp	His	Met
		565		570	
Pro	Glu	Gly	Tyr	Val	Gln
		580		585	
Asn	Tyr	Lys	Thr	Arg	Ala
		595		600	
Asn	Arg	Ile	Glu	Leu	Lys
		610		615	
Leu	Gly	His	Lys	Leu	Glu
		625		630	
Met	Ala	Asp	Lys	Gln	Lys
		645		650	
His	Asn	Ile	Glu	Asp	Gly
		660		665	
Asn	Thr	Pro	Ile	Gly	Asp
		675		680	
Leu	Ser	Thr	Gln	Ser	Ala
		690		695	
His	Met	Val	Leu	Leu	Glu
		705		710	
Met	Asp	Glu	Leu	Tyr	Lys
				725	

## (2) INFORMATION FOR SEQ ID NO:72:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2751 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2748
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:72:

ATG	GCT	GAC	GTT	TAC	CCG	GCC	AAC	GAC	TCC	ACG	GCG	TCT	CAG	GAC	GTG	48
Met	Ala	Asp	Val	Tyr	Pro	Ala	Asn	Asp	Ser	Thr	Ala	Ser	Gln	Asp	Val	
1			5						10				15			
GCC	AAC	CGC	TTC	GCC	CGC	AAA	GGG	GCG	CTG	AGG	CAG	AAG	AAC	GTG	CAT	96
Ala	Asn	Arg	Phe	Ala	Arg	Lys	Gly	Ala	Leu	Arg	Gln	Lys	Asn	Val	His	
			20					25					30			
GAG	GTG	AAA	GAC	CAC	AAA	TTC	ATC	GCC	CGC	TTC	TTC	AAG	CAA	CCC	ACC	144
Glu	Val	Lys	Asp	His	Lys	Phe	Ile	Ala	Arg	Phe	Phe	Lys	Gln	Pro	Thr	
			35				40					45				
TTC	TGC	AGC	CAC	TGC	ACC	GAC	TTC	ATC	TGG	GGG	TTT	GGG	AAA	CAA	GGC	192
Phe	Cys	Ser	His	Cys	Thr	Asp	Phe	Ile	Trp	Gly	Phe	Gly	Lys	Gln	Gly	
50							55					60				

TTC CAG TGC CAA GTT TGC TGT TTT GTG GTT CAT AAG AGG TGC CAT GAG	240
Phe Gln Cys Gln Val Cys Cys Phe Val Val His Lys Arg Cys His Glu	
65 70 75 80	
TTC GTT ACG TTC TCT TGT CCG GGT GCG GAT AAG GGA CCT GAC ACT GAC	288
Phe Val Thr Phe Ser Cys Pro Gly Ala Asp Lys Gly Pro Asp Thr Asp	
85 90 95	
GAC CCC AGG AGC AAG CAC AAG TTC AAA ATC CAC ACA TAC GGA AGC CCT	336
Asp Pro Arg Ser Lys His Lys Phe Lys Ile His Thr Tyr Gly Ser Pro	
100 105 110	
ACC TTC TGT GAT CAC TGT GGG TCC CTG CTC TAT GGA CTT ATC CAC CAA	384
Thr Phe Cys Asp His Cys Gly Ser Leu Leu Tyr Gly Leu Ile His Gln	
115 120 125	
GGG ATG AAA TGT GAC ACC TGC GAC ATG AAT GTT CAC AAC CAG TGT GTG	432
Gly Met Lys Cys Asp Thr Cys Asp Met Asn Val His Asn Gln Cys Val	
130 135 140	
ATC AAT GAC CCT AGC CTC TGC GGA ATG GAT CAC ACA GAG AAG AGG GGG	480
Ile Asn Asp Pro Ser Leu Cys Gly Met Asp His Thr Glu Lys Arg Gly	
145 150 155 160	
CGG ATT TAT CTG AAG GCT GAG GTC ACT GAT GAA AAG CTC CAC GTC ACG	528
Arg Ile Tyr Leu Lys Ala Glu Val Thr Asp Glu Lys Leu His Val Thr	
165 170 175	
GTA CGA GAT GCA AAA AAT CTA ATC CCT ATG GAT CCA AAT GGG CTT TCG	576
Val Arg Asp Ala Lys Asn Leu Ile Pro Met Asp Pro Asn Gly Leu Ser	
180 185 190	
GAT CCT TAT GTG AAG CTG AAA CTA ATC CCT GAC CCC AAG AAT GAG AGC	624
Asp Pro Tyr Val Lys Leu Lys Leu Ile Pro Asp Pro Lys Asn Glu Ser	
195 200 205	
AAA CAG AAA ACC AAA ACC ATC CGC TCC AAC CTG AAT CCT CAG TGG AAT	672
Lys Gln Lys Thr Lys Thr Ile Arg Ser Asn Leu Asn Pro Gln Trp Asn	
210 215 220	
GAG TCC TTC ACG TTC AAA TTA AAA CCT TCA GAC AAA GAC CGG CGA CTG	720
Glu Ser Phe Thr Phe Lys Leu Lys Pro Ser Asp Lys Asp Arg Arg Leu	
225 230 235 240	
TCT GTA GAA ATC TGG GAC TGG GAT CGG ACG ACT CGG AAT GAC TTC ATG	768
Ser Val Glu Ile Trp Asp Trp Asp Arg Thr Thr Arg Asn Asp Phe Met	
245 250 255	
GGA TCC CTT TCC TTT GGT GTC TCA GAG CTA ATG AAG ATG CCG GCC AGT	816
Gly Ser Leu Ser Phe Gly Val Ser Glu Leu Met Lys Met Pro Ala Ser	
260 265 270	
GGA TGG TAT AAA GCT CAC AAC CAA GAA GAG GGC GAA TAT TAC AAC GTG	864
Gly Trp Tyr Lys Ala His Asn Gln Glu Glu Gly Glu Tyr Tyr Asn Val	
275 280 285	
CCC ATT CCA GAA GGA GAT GAA GAA GGC AAC ATG GAA CTC AGG CAG AAG	912

Pro Ile Pro Glu Gly Asp Glu Glu Gly Asn Met Glu Leu Arg Gln Lys	
290 295 300	
TTT GAG AAA GCC AAG CTA GGT CCT GTT GGT AAC AAA GTC ATC AGC CCT	960
Phe Glu Lys Ala Lys Leu Gly Pro Val Gly Asn Lys Val Ile Ser Pro	
305 310 315 320	
TCA GAA GAC AGA AAG CAA CCA TCC AAC AAC CTG GAC AGA GTG AAA CTC	1008
Ser Glu Asp Arg Lys Gln Pro Ser Asn Asn Leu Asp Arg Val Lys Leu	
325 330 335	
ACA GAC TTC AAC TTC CTC ATG GTG CTG GGG AAG GGG AGT TTT GGG AAG	1056
Thr Asp Phe Asn Phe Leu Met Val Leu Gly Lys Gly Ser Phe Gly Lys	
340 345 350	
GTG ATG CTT GCT GAC AGG AAG GGA ACG GAG GAA CTG TAC GCC ATC AAG	1104
Val Met Leu Ala Asp Arg Lys Gly Thr Glu Glu Leu Tyr Ala Ile Lys	
355 360 365	
ATC CTG AAG AAG GAC GTG GTG ATC CAG GAC GAC GAC GTG GAG TGC ACC	1152
Ile Leu Lys Lys Asp Val Val Ile Gln Asp Asp Asp Val Glu Cys Thr	
370 375 380	
ATG GTG GAG AAG CGC GTG CTG GCC CTG CTG GAC AAG CCG CCA TTT CTG	1200
Met Val Glu Lys Arg Val Leu Ala Leu Asp Lys Pro Pro Phe Leu	
385 390 395 400	
ACA CAG CTG CAC TCC TGC TTC CAG ACA GTG GAC CGG CTG TAC TTC GTC	1248
Thr Gln Leu His Ser Cys Phe Gln Thr Val Asp Arg Leu Tyr Phe Val	
405 410 415	
ATG GAA TAC GTC AAC GGC GGG GAT CTT ATG TAC CAC ATT CAG CAA GTC	1296
Met Glu Tyr Val Asn Gly Gly Asp Leu Met Tyr His Ile Gln Gln Val	
420 425 430	
GGG AAA TTT AAG GAG CCA CAA GCA GTA TTC TAC GCA GCC GAG ATC TCC	1344
Gly Lys Phe Lys Glu Pro Gln Ala Val Phe Tyr Ala Ala Glu Ile Ser	
435 440 445	
ATC GGA CTG TTC TTC CTT CAT AAA AGA GGG ATC ATT TAC AGG GAT CTG	1392
Ile Gly Leu Phe Phe Leu His Lys Arg Gly Ile Ile Tyr Arg Asp Leu	
450 455 460	
AAG CTG AAC AAT GTC ATG CTG AAC TCA GAA GGG CAC ATC AAA ATC GCC	1440
Lys Leu Asn Asn Val Met Leu Asn Ser Glu Gly His Ile Lys Ile Ala	
465 470 475 480	
GAC TTC GGG ATG TGC AAG GAA CAC ATG ATG GAT GGA GTC ACG ACC AGG	1488
Asp Phe Gly Met Cys Lys Glu His Met Met Asp Gly Val Thr Arg	
485 490 495	
ACC TTC TGC GGA ACT CCG GAC TAC ATT GCC CCA GAG ATA ATC GCT TAC	1536
Thr Phe Cys Gly Thr Pro Asp Tyr Ile Ala Pro Glu Ile Ile Ala Tyr	
500 505 510	
CAG CCG TAC GGG AAG TCT GTA GAT TGG TGG GCG TAC GGT GTG CTG CTG	1584
Gln Pro Tyr Gly Lys Ser Val Asp Trp Trp Ala Tyr Gly Val Leu Leu	
515 520 525	

TAC GAG ATG CTA GCC GGG CAG CCT CCG TTT GAT GGT GAA GAT GAA GAT	1632
Tyr Glu Met Leu Ala Gly Gln Pro Pro Phe Asp Gly Glu Asp Glu Asp	
530 535 540	
GAA CTG TTT CAG TCT ATA ATG GAG CAC AAC GTG TCC TAC CCC AAA TCC	1680
Glu Leu Phe Gln Ser Ile Met Glu His Asn Val Ser Tyr Pro Lys Ser	
545 550 555 560	
TTG TCC AAG GAA GCC GTC TCC ATC TGC AAA GGA CTT ATG ACC AAA CAG	1728
Leu Ser Lys Glu Ala Val Ser Ile Cys Lys Gly Leu Met Thr Lys Gln	
565 570 575	
CCT GCC AAG CGA CTG GGC TGC GGG CCC GAG GGA GAG AGG GAT GTC AGA	1776
Pro Ala Lys Arg Leu Gly Cys Gly Pro Glu Gly Glu Arg Asp Val Arg	
580 585 590	
GAG CAT GCC TTC TTC AGG AGG ATC GAC TGG GAG AAA CTG GAG AAC AGG	1824
Glu His Ala Phe Phe Arg Arg Ile Asp Trp Glu Lys Leu Glu Asn Arg	
595 600 605	
GAG ATC CAA CCA CCA TTC AAG CCC AAA GTG TGT GGC AAA GGA GCA GAA	1872
Glu Ile Gln Pro Pro Phe Lys Pro Lys Val Cys Gly Lys Gly Ala Glu	
610 615 620	
AAC TTT GAC AAG TTC TTC ACG CGA GGA CAG CCT GTC TTA ACA CCA CCA	1920
Asn Phe Asp Lys Phe Phe Thr Arg Gly Gln Pro Val Leu Thr Pro Pro	
625 630 635 640	
GAT CAG CTG GTC ATT GCT AAC ATA GAC CAA TCT GAT TTT GAA GGG TTC	1968
Asp Gln Leu Val Ile Ala Asn Ile Asp Gln Ser Asp Phe Glu Gly Phe	
645 650 655	
TCG TAT GTC AAC CCC CAG TTT GTG CAC CCA ATC TTG CAA AGT GCA GTA	2016
Ser Tyr Val Asn Pro Gln Phe Val His Pro Ile Leu Gln Ser Ala Val	
660 665 670	
GGG CGC GCC ATG AGT AAA GGA GAA GAA CTT TTC ACT GGA GTT GTC CCA	2064
Gly Arg Ala Met Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro	
675 680 685	
ATT CTT GTT GAA TTA GAT GGC GAT GTT AAT GGG CAA AAA TTC TCT GTT	2112
Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly Gln Lys Phe Ser Val	
690 695 700	
AGT GGA GAG GGT GAA GGT GAT GCA ACA TAC GGA AAA CTT ACC CTT AAA	2160
Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys	
705 710 715 720	
TTT ATT TGC ACT ACT GGG AAG CTA CCT GTT CCA TGG CCA ACG CTT GTC	2208
Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val	
725 730 735	
ACT ACT CTC ACT TAT GGT GTT CAA TGC TTT TCT AGA TAC CCA GAT CAT	2256
Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His	
740 745 750	
ATG AAA CAG CAT GAC TTT TTC AAG AGT GCC ATG CCC GAA GGT TAT GTA	2304

Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val	
755 760 765	
CAG GAA AGA ACT ATA TTT TAC AAA GAT GAC GGG AAC TAC AAG ACA CGT	2352
Gln Glu Arg Thr Ile Phe Tyr Lys Asp Asp Gly Asn Tyr Lys Thr Arg	
770 775 780	
GCT GAA GTC AAG TTT GAA GGT GAT ACC CTT GTT AAT AGA ATC GAG TTA	2400
Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu	
785 790 795 800	
AAA GGT ATT GAT TTT AAA GAA GAT GGA AAC ATT CTT GGA CAC AAA ATG	2448
Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Met	
805 810 815	
GAA TAC AAT TAT AAC TCA CAT AAT GTA TAC ATC ATG GCA GAC AAA CCA	2496
Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Pro	
820 825 830	
AAG AAT GGC ATC AAA GTT AAC TTC AAA ATT AGA CAC AAC ATT AAA GAT	2544
Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Lys Asp	
835 840 845	
GGA AGC GTT CAA TTA GCA GAC CAT TAT CAA CAA AAT ACT CCA ATT GGC	2592
Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly	
850 855 860	
GAT GGC CCT GTC CTT TTA CCA GAC AAC CAT TAC CTG TCC ACG CAA TCT	2640
Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser	
865 870 875 880	
GCC CTT TCC AAA GAT CCC AAC GAA AAG AGA GAT CAC ATG ATC CTT CTT	2688
Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Ile Leu Leu	
885 890 895	
GAG TTT GTA ACA GCT GCT GGG ATT ACA CAT GGC ATG GAT GAA CTA TAC	2736
Glu Phe Val Thr Ala Ala Gly Ile Thr His Gly Met Asp Glu Leu Tyr	
900 905 910	
AAA CCT CAG GAG TAA	2751
Lys Pro Gln Glu	
915	

## (2) INFORMATION FOR SEQ ID NO:73:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 916 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:73:

Met Ala Asp Val Tyr Pro Ala Asn Asp Ser Thr Ala Ser Gln Asp Val



1	5	10	15
Ala Asn Arg Phe	Ala Arg Lys Gly Ala	Leu Arg Gln Lys Asn Val His	
20	25	30	
Glu Val Lys Asp His	Lys Phe Ile Ala Arg Phe Phe	Lys Gln Pro Thr	
35	40	45	
Phe Cys Ser His Cys	Thr Asp Phe Ile Trp Gly Phe Gly	Lys Gln Gly	
50	55	60	
Phe Gln Cys Gln Val	Cys Phe Val Val His Lys Arg Cys	His Glu	
65	70	75	80
Phe Val Thr Phe Ser	Cys Pro Gly Ala Asp Lys Gly Pro	Asp Thr Asp	
85	90	95	
Asp Pro Arg Ser Lys	His Lys Phe Lys Ile His Thr Tyr	Gly Ser Pro	
100	105	110	
Thr Phe Cys Asp His	Cys Gly Ser Leu Leu Tyr Gly Leu	Ile His Gln	
115	120	125	
Gly Met Lys Cys Asp	Thr Cys Asp Met Asn Val His Asn	Gln Cys Val	
130	135	140	
Ile Asn Asp Pro Ser	Leu Cys Gly Met Asp His Thr Glu	Lys Arg Gly	
145	150	155	160
Arg Ile Tyr Leu Lys	Ala Glu Val Thr Asp Glu Lys Leu	His Val Thr	
165	170	175	
Val Arg Asp Ala Lys	Asn Leu Ile Pro Met Asp Pro Asn	Gly Leu Ser	
180	185	190	
Asp Pro Tyr Val Lys	Leu Lys Leu Ile Pro Asp Pro Lys	Asn Glu Ser	
195	200	205	
Lys Gln Lys Thr Lys	Thr Ile Arg Ser Asn Leu Asn Pro	Gln Trp Asn	
210	215	220	
Glu Ser Phe Thr Phe	Lys Leu Lys Pro Ser Asp Lys Asp	Arg Arg Leu	
225	230	235	240
Ser Val Glu Ile Trp	Asp Trp Asp Arg Thr Thr Arg Asn	Asp Phe Met	
245	250	255	
Gly Ser Leu Ser Phe	Gly Val Ser Glu Leu Met Lys Met	Pro Ala Ser	
260	265	270	
Gly Trp Tyr Lys Ala	His Asn Gln Glu Glu Gly Glu Tyr	Tyr Asn Val	
275	280	285	
Pro Ile Pro Glu Gly	Asp Glu Glu Gly Asn Met Glu Leu	Arg Gln Lys	
290	295	300	
Phe Glu Lys Ala Lys	Leu Gly Pro Val Gly Asn Lys Val	Ile Ser Pro	
305	310	315	320
Ser Glu Asp Arg Lys	Gln Pro Ser Asn Asn Leu Asp Arg	Val Lys Leu	
325	330	335	
Thr Asp Phe Asn Phe	Leu Met Val Leu Gly Lys Gly Ser	Phe Gly Lys	
340	345	350	
Val Met Leu Ala Asp	Arg Lys Gly Thr Glu Glu Leu Tyr	Ala Ile Lys	
355	360	365	
Ile Leu Lys Lys Asp	Val Val Ile Gln Asp Asp Asp Val	Glu Cys Thr	
370	375	380	
Met Val Glu Lys Arg	Val Leu Ala Leu Leu Asp Lys Pro	Pro Phe Leu	
385	390	395	400
Thr Gln Leu His Ser	Cys Phe Gln Thr Val Asp Arg Leu	Tyr Phe Val	
405	410	415	
Met Glu Tyr Val Asn	Gly Gly Asp Leu Met Tyr His Ile	Gln Gln Val	
420	425	430	
Gly Lys Phe Lys Glu	Pro Gln Ala Val Phe Tyr Ala Ala	Glu Ile Ser	
435	440	445	
Ile Gly Leu Phe Phe	Leu His Lys Arg Gly Ile Ile Tyr	Arg Asp Leu	
450	455	460	
Lys Leu Asn Asn Val	Met Leu Asn Ser Glu Gly His Ile	Lys Ile Ala	

Lys Pro Gln Glu  
915

## (2) INFORMATION FOR SEQ ID NO:74:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2157 base pairs  
 (B) TYPE: nucleic acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
 (B) LOCATION: 1...2154  
 (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:74:

ATG TCG TCC ATC TTG CCA TTC ACG CCG CCA GTT GTG AAG AGA CTG CTG	48
Met Ser Ser Ile Leu Pro Phe Thr Pro Pro Val Val Lys Arg Leu Leu	
1 5 10 15	
GGA TGG AAG AAG TCA GCT GGT GGG TCT GGA GGA GCA GGC GGA GGA GAG	96
Gly Trp Lys Lys Ser Ala Gly Gly Ser Gly Gly Ala Gly Gly Gly Glu	
20 25 30	
CAG AAT GGG CAG GAA GAA AAG TGG TGT GAG AAA GCA GTG AAA AGT CTG	144
Gln Asn Gly Gln Glu Glu Lys Trp Cys Glu Lys Ala Val Lys Ser Leu	
35 40 45	
GTG AAG AAG CTA AAG AAA ACA GGA CGA TTA GAT GAG CTT GAG AAA GCC	192
Val Lys Lys Leu Lys Lys Thr Gly Arg Leu Asp Glu Leu Glu Lys Ala	
50 55 60	
ATC ACC ACT CAA AAC TGT AAT ACT AAA TGT GTT ACC ATA CCA AGC ACT	240
Ile Thr Thr Gln Asn Cys Asn Thr Lys Cys Val Thr Ile Pro Ser Thr	
65 70 75 80	
TGC TCT GAA ATT TGG GGA CTG AGT ACA CCA AAT ACG ATA GAT CAG TGG	288
Cys Ser Glu Ile Trp Gly Leu Ser Thr Pro Asn Thr Ile Asp Gln Trp	
85 90 95	
GAT ACA ACA GGC CTT TAC AGC TTC TCT GAA CAA ACC AGG TCT CTT GAT	336
Asp Thr Thr Gly Leu Tyr Ser Phe Ser Glu Gln Thr Arg Ser Leu Asp	
100 105 110	
GGT CGT CTC CAG GTA TCC CAT CGA AAA GGA TTG CCA CAT GTT ATA TAT	384
Gly Arg Leu Gln Val Ser His Arg Lys Gly Leu Pro His Val Ile Tyr	
115 120 125	
TGC CGA TTA TGG CGC TGG CCT GAT CTT CAC AGT CAT CAT GAA CTC AAG	432
Cys Arg Leu Trp Arg Trp Pro Asp Leu His Ser His His Glu Leu Lys	
130 135 140	
GCA ATT GAA AAC TGC GAA TAT GCT TTT AAT CTT AAA AAG GAT GAA GTA	480
Ala Ile Glu Asn Cys Glu Tyr Ala Phe Asn Leu Lys Lys Asp Glu Val	
145 150 155 160	
TGT GTA AAC CCT TAC CAC TAT CAG AGA GTT GAG ACA CCA GTT TTG CCT	528

Cys	Val	Asn	Pro	Tyr	His	Tyr	Gln	Arg	Val	Glu	Thr	Pro	Val	Leu	Pro	
				165					170					175		
CCA	GTA	TTA	GTG	CCC	CGA	CAC	ACC	GAG	ATC	CTA	ACA	GAA	CTT	CCG	CCT	576
Pro	Val	Leu	Val	Pro	Arg	His	Thr	Glu	Ile	Leu	Thr	Glu	Leu	Pro	Pro	
			180					185					190			
CTG	GAT	GAC	TAT	ACT	CAC	TCC	ATT	CCA	GAA	AAC	ACT	AAC	TTC	CCA	GCA	624
Leu	Asp	Asp	Tyr	Thr	His	Ser	Ile	Pro	Glu	Asn	Thr	Asn	Phe	Pro	Ala	
		195					200					205				
GGA	ATT	GAG	CCA	CAG	AGT	AAT	TAT	ATT	CCA	GAA	ACG	CCA	CCT	CCT	GGA	672
Gly	Ile	Glu	Pro	Gln	Ser	Asn	Tyr	Ile	Pro	Glu	Thr	Pro	Pro	Pro	Gly	
	210						215					220				
TAT	ATC	AGT	GAA	GAT	GGA	GAA	ACA	AGT	GAC	CAA	CAG	TTG	AAT	CAA	AGT	720
Tyr	Ile	Ser	Glu	Asp	Gly	Glu	Thr	Ser	Asp	Gln	Gln	Leu	Asn	Gln	Ser	
	225				230					235					240	
ATG	GAC	ACA	GGC	TCT	CCA	GCA	GAA	CTA	TCT	CCT	ACT	ACT	CTT	TCC	CCT	768
Met	Asp	Thr	Gly	Ser	Pro	Ala	Glu	Leu	Ser	Pro	Thr	Thr	Leu	Ser	Pro	
			245						250					255		
GTT	AAT	CAT	AGC	TTG	GAT	TTA	CAG	CCA	GTT	ACT	TAC	TCA	GAA	CCT	GCA	816
Val	Asn	His	Ser	Leu	Asp	Leu	Gln	Pro	Val	Thr	Tyr	Ser	Glu	Pro	Ala	
			260					265						270		
TTT	TGG	TGT	TCA	ATA	GCA	TAT	TAT	GAA	TTA	AAT	CAG	AGG	GTT	GGA	GAA	864
Phe	Trp	Cys	Ser	Ile	Ala	Tyr	Tyr	Glu	Leu	Asn	Gln	Arg	Val	Gly	Glu	
		275						280					285			
ACC	TTC	CAT	GCA	TCA	CAG	CCC	TCA	CTC	ACT	GTA	GAT	GGC	TTT	ACA	GAC	912
Thr	Phe	His	Ala	Ser	Gln	Pro	Ser	Leu	Thr	Val	Asp	Gly	Phe	Thr	Asp	
		290					295					300				
CCA	TCA	AAT	TCA	GAG	AGG	TTC	TGC	TTA	GGT	TTA	CTC	TCC	AAT	GTT	AAC	960
Pro	Ser	Asn	Ser	Glu	Arg	Phe	Cys	Leu	Gly	Leu	Leu	Ser	Asn	Val	Asn	
					310					315					320	
CGA	AAT	GCC	ACG	GTA	GAA	ATG	ACA	AGA	AGG	CAT	ATA	GGA	AGA	GGA	GTG	1008
Arg	Asn	Ala	Thr	Val	Glu	Met	Thr	Arg	Arg	His	Ile	Gly	Arg	Gly	Val	
				325					330					335		
CGC	TTA	TAC	TAC	ATA	GGT	GGG	GAA	GTT	TTT	GCT	GAG	TGC	CTA	AGT	GAT	1056
Arg	Leu	Tyr	Tyr	Ile	Gly	Gly	Glu	Val	Phe	Ala	Glu	Cys	Leu	Ser	Asp	
			340					345					350			
AGT	GCA	ATC	TTT	GTG	CAG	AGC	CCC	AAT	TGT	AAT	CAG	AGA	TAT	GGC	TGG	1104
Ser	Ala	Ile	Phe	Val	Gln	Ser	Pro	Asn	Cys	Asn	Gln	Arg	Tyr	Gly	Trp	
		355						360				365				
CAC	CCT	GCA	ACA	GTG	TGT	AAA	ATT	CCA	CCA	GGC	TGT	AAT	CTG	AAG	ATC	1152
His	Pro	Ala	Thr	Val	Cys	Lys	Ile	Pro	Pro	Gly	Cys	Asn	Leu	Lys	Ile	
		370					375					380				
TTC	AAC	AAC	CAG	GAA	TTT	GCT	GCT	CTT	CTG	GCT	CAG	TCT	GTT	AAT	CAG	1200
Phe	Asn	Asn	Gln	Glu	Phe	Ala	Ala	Leu	Leu	Ala	Gln	Ser	Val	Asn	Gln	
					385		390			395					400	

GGT TTT GAA GCC GTC TAT CAG CTA ACT AGA ATG TGC ACC ATA AGA ATG Gly Phe Glu Ala Val Tyr Gln Leu Thr Arg Met Cys Thr Ile Arg Met 405 410 415	1248
AGT TTT GTG AAA GGG TGG GGA GCA GAA TAC CGA AGG CAG ACG GTA ACA Ser Phe Val Lys Gly Trp Gly Ala Glu Tyr Arg Arg Gln Thr Val Thr 420 425 430	1296
AGT ACT CCT TGC TGG ATT GAA CTT CAT CTG AAT GGA CCT CTA CAG TGG Ser Thr Pro Cys Trp Ile Glu Leu His Leu Asn Gly Pro Leu Gln Trp 435 440 445	1344
TTG GAC AAA GTA TTA ACT CAG ATG GGA TCC CCT TCA GTG CGT TGC TCA Leu Asp Lys Val Leu Thr Gln Met Gly Ser Pro Ser Val Arg Cys Ser 450 455 460	1392
AGC ATG TCA TGG GTA CCG CGG GCC CGG GAT CCA CCG GTC GCC ACC ATG Ser Met Ser Trp Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr Met 465 470 475 480	1440
GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG GTC Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val 485 490 495	1488
GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC GAG Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu 500 505 510	1536
GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC TGC Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys 515 520 525	1584
ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC CTG Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu 530 535 540	1632
ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG CAG Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln 545 550 555 560	1680
CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg 565 570 575	1728
ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val 580 585 590	1776
AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile 595 600 605	1824
GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn 610 615 620	1872
TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC	1920

Tyr 625	Asn	Ser	His	Asn	Val 630	Tyr	Ile	Met	Ala	Asp 635	Lys	Gln	Lys	Asn	Gly 640	
ATC Ile	AAG Lys	GTG Val	AAC Asn	TTC Phe	AAG Lys	ATC Ile	CGC Arg	CAC His	AAC Asn	ATC Ile	GAG Glu	GAC Asp	GGC Gly	AGC Ser	GTG Val	1968
CAG Gln	CTC Leu	GCC Ala	GAC Asp	CAC His	TAC Tyr	CAG Gln	CAG Gln	AAC Asn	ACC Thr	CCC Pro	ATC Ile	GGC Gly	GAC Asp	GGC Gly	CCC Pro	2016
GTG Val	CTG Leu	CTG Leu	CCC Pro	GAC Asp	AAC Asn	CAC His	TAC Tyr	CTG Leu	AGC Ser	ACC Thr	CAG Gln	TCC Ser	GCC Ala	CTG Leu	AGC Ser	2064
AAA Lys	GAC Asp	CCC Pro	AAC Asn	GAG Glu	AAG Lys	CGC Arg	GAT Asp	CAC His	ATG Met	GTC Val	CTG Leu	CTG Leu	GAG Glu	TTC Phe	GTG Val	2112
ACC Thr	GCC Ala	GCC Ala	GGG Gly	ATC Ile	ACT Thr	CTC Leu	GGC Gly	ATG Met	GAC Asp	GAG Glu	CTG Leu	TAC Tyr	AAG Lys	TAA		2157

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 718 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:75:

Met	Ser	Ser	Ile	Leu	Pro	Phe	Thr	Pro	Pro	Val	Val	Lys	Arg	Leu	Leu
1				5					10					15	
Gly	Trp	Lys	Lys	Ser	Ala	Gly	Gly	Ser	Gly	Gly	Ala	Gly	Gly	Gly	Glu
		20						25					30		
Gln	Asn	Gly	Gln	Glu	Glu	Lys	Trp	Cys	Glu	Lys	Ala	Val	Lys	Ser	Leu
		35					40					45			
Val	Lys	Lys	Leu	Lys	Lys	Thr	Gly	Arg	Leu	Asp	Glu	Leu	Glu	Lys	Ala
	50					55					60				
Ile	Thr	Thr	Gln	Asn	Cys	Asn	Thr	Lys	Cys	Val	Thr	Ile	Pro	Ser	Thr
65				70						75					80
Cys	Ser	Glu	Ile	Trp	Gly	Leu	Ser	Thr	Pro	Asn	Thr	Ile	Asp	Gln	Trp
			85						90				95		
Asp	Thr	Thr	Gly	Leu	Tyr	Ser	Phe	Ser	Glu	Gln	Thr	Arg	Ser	Leu	Asp
			100					105					110		
Gly	Arg	Leu	Gln	Val	Ser	His	Arg	Lys	Gly	Leu	Pro	His	Val	Ile	Tyr
		115					120					125			
Cys	Arg	Leu	Trp	Arg	Trp	Pro	Asp	Leu	His	Ser	His	His	Glu	Leu	Lys
	130					135					140				
Ala	Ile	Glu	Asn	Cys	Glu	Tyr	Ala	Phe	Asn	Leu	Lys	Lys	Asp	Glu	Val
145				150						155					160
Cys	Val	Asn	Pro	Tyr	His	Tyr	Gln	Arg	Val	Glu	Thr	Pro	Val	Leu	Pro



625		630		635		640
Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val						
		645		650		655
Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro						
		660		665		670
Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser						
		675		680		685
Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val						
		690		695		700
Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys						
705		710		715		

## (2) INFORMATION FOR SEQ ID NO:76:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2397 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2394
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:76:

ATG GAC AAT ATG TCT ATT ACG AAT ACA CCA ACA AGT AAT GAT GCC TGT	48
Met Asp Asn Met Ser Ile Thr Asn Thr Pro Thr Ser Asn Asp Ala Cys	
1 5 10 15	
CTG AGC ATT GTG CAT AGT TTG ATG TGC CAT AGA CAA GGT GGA GAG AGT	96
Leu Ser Ile Val His Ser Leu Met Cys His Arg Gln Gly Gly Glu Ser	
20 25 30	
GAA ACA TTT GCA AAA AGA GCA ATT GAA AGT TTG GTA AAG AAG CTG AAG	144
Glu Thr Phe Ala Lys Arg Ala Ile Glu Ser Leu Val Lys Lys Leu Lys	
35 40 45	
GAG AAA AAA GAT GAA TTG GAT TCT TTA ATA ACA GCT ATA ACT ACA AAT	192
Glu Lys Lys Asp Glu Leu Asp Ser Leu Ile Thr Ala Ile Thr Thr Asn	
50 55 60	
GGA GCT CAT CCT AGT AAA TGT GTT ACC ATA CAG AGA ACA TTG GAT GGG	240
Gly Ala His Pro Ser Lys Cys Val Thr Ile Gln Arg Thr Leu Asp Gly	
65 70 75 80	
AGG CTT CAG GTG GCT GGT CGG AAA GGA TTT CCT CAT GTG ATC TAT GCC	288
Arg Leu Gln Val Ala Gly Arg Lys Gly Phe Pro His Val Ile Tyr Ala	
85 90 95	
CGT CTC TGG AGG TGG CCT GAT CTT CAC AAA AAT GAA CTA AAA CAT GTT	336
Arg Leu Trp Arg Trp Pro Asp Leu His Lys Asn Glu Leu Lys His Val	
100 105 110	
AAA TAT TGT CAG TAT GCG TTT GAC TTA AAA TGT GAT AGT GTC TGT GTG	384



Lys Tyr Cys Gln Tyr Ala Phe Asp Leu Lys Cys Asp Ser Val Cys Val	
115 120 125	
AAT CCA TAT CAC TAC GAA CGA GTT GTA TCA CCT GGA ATT GAT CTC TCA	432
Asn Pro Tyr His Tyr Glu Arg Val Val Ser Pro Gly Ile Asp Leu Ser	
130 135 140	
GGA TTA ACA CTG CAG AGT AAT GCT CCA TCA AGT ATG ATG GTG AAG GAT	480
Gly Leu Thr Leu Gln Ser Asn Ala Pro Ser Ser Met Met Val Lys Asp	
145 150 155 160	
GAA TAT GTG CAT GAC TTT GAG GGA CAG CCA TCG TTG TCC ACT GAA GGA	528
Glu Tyr Val His Asp Phe Glu Gly Gln Pro Ser Leu Ser Thr Glu Gly	
165 170 175	
CAT TCA ATT CAA ACC ATC CAG CAT CCA CCA AGT AAT CGT GCA TCG ACA	576
His Ser Ile Gln Thr Ile Gln His Pro Pro Ser Asn Arg Ala Ser Thr	
180 185 190	
GAG ACA TAC AGC ACC CCA GCT CTG TTA GCC CCA TCT GAG TCT AAT GCT	624
Glu Thr Tyr Ser Thr Pro Ala Leu Leu Ala Pro Ser Glu Ser Asn Ala	
195 200 205	
ACC AGC ACT GCC AAC TTT CCC AAC ATT CCT GTG GCT TCC ACA AGT CAG	672
Thr Ser Thr Ala Asn Phe Pro Asn Ile Pro Val Ala Ser Thr Ser Gln	
210 215 220	
CCT GCC AGT ATA CTG GGG GGC AGC CAT AGT GAA GGA CTG TTG CAG ATA	720
Pro Ala Ser Ile Leu Gly Gly Ser His Ser Glu Gly Leu Leu Gln Ile	
225 230 235 240	
GCA TCA GGG CCT CAG CCA GGA CAG CAG CAG AAT GGA TTT ACT GGT CAG	768
Ala Ser Gly Pro Gln Pro Gly Gln Gln Gln Asn Gly Phe Thr Gly Gln	
245 250 255	
CCA GCT ACT TAC CAT CAT AAC AGC ACT ACC ACC TGG ACT GGA AGT AGG	816
Pro Ala Thr Tyr His His Asn Ser Thr Thr Thr Trp Thr Gly Ser Arg	
260 265 270	
ACT GCA CCA TAC ACA CCT AAT TTG CCT CAC CAC CAA AAC GGC CAT CTT	864
Thr Ala Pro Tyr Thr Pro Asn Leu Pro His His Gln Asn Gly His Leu	
275 280 285	
CAG CAC CAC CCG CCT ATG CCG CCC CAT CCC GGA CAT TAC TGG CCT GTT	912
Gln His His Pro Pro Met Pro Pro His Pro Gly His Tyr Trp Pro Val	
290 295 300	
CAC AAT GAG CTT GCA TTC CAG CCT CCC ATT TCC AAT CAT CCT GCT CCT	960
His Asn Glu Leu Ala Phe Gln Pro Pro Ile Ser Asn His Pro Ala Pro	
305 310 315 320	
GAG TAT TGG TGT TCC ATT GCT TAC TTT GAA ATG GAT GTT CAG GTA GGA	1008
Glu Tyr Trp Cys Ser Ile Ala Tyr Phe Glu Met Asp Val Gln Val Gly	
325 330 335	
GAG ACA TTT AAG GTT CCT TCA AGC TGC CCT ATT GTT ACT GTT GAT GGA	1056
Glu Thr Phe Lys Val Pro Ser Ser Cys Pro Ile Val Thr Val Asp Gly	
340 345 350	

TAC GTG GAC CCT TCT GGA GGA GAT CGC TTT TGT TTG GGT CAA CTC TCC	1104
Tyr Val Asp Pro Ser Gly Gly Asp Arg Phe Cys Leu Gly Gln Leu Ser	
355 360 365	
AAT GTC CAC AGG ACA GAA GCC ATT GAG AGA GCA AGG TTG CAC ATA GGC	1152
Asn Val His Arg Thr Glu Ala Ile Glu Arg Ala Arg Leu His Ile Gly	
370 375 380	
AAA GGT GTG CAG TTG GAA TGT AAA GGT GAA GGT GAT GTT TGG GTC AGG	1200
Lys Gly Val Gln Leu Glu Cys Lys Gly Glu Gly Asp Val Trp Val Arg	
385 390 395 400	
TGC CTT AGT GAC CAC GCG GTC TTT GTA CAG AGT TAC TAC TTA GAC AGA	1248
Cys Leu Ser Asp His Ala Val Phe Val Gln Ser Tyr Tyr Leu Asp Arg	
405 410 415	
GAA GCT GGG CGT GCA CCT GGA GAT GCT GTT CAT AAG ATC TAC CCA AGT	1296
Glu Ala Gly Arg Ala Pro Gly Asp Ala Val His Lys Ile Tyr Pro Ser	
420 425 430	
GCA TAT ATA AAG GTC TTT GAT TTG CGT CAG TGT CAT CGA CAG ATG CAG	1344
Ala Tyr Ile Lys Val Phe Asp Leu Arg Gln Cys His Arg Gln Met Gln	
435 440 445	
CAG CAG GCG GCT ACT GCA CAA GCT GCA GCA GCT GCC CAG GCA GCA GCC	1392
Gln Gln Ala Ala Thr Ala Gln Ala Ala Ala Ala Ala Gln Ala Ala Ala	
450 455 460	
GTG GCA GGA AAC ATC CCT GGC CCA GGA TCA GTA GGT GGA ATA GCT CCA	1440
Val Ala Gly Asn Ile Pro Gly Pro Gly Ser Val Gly Gly Ile Ala Pro	
465 470 475 480	
GCT ATC AGT CTG TCA GCT GCT GCT GGA ATT GGT GTT GAT GAC CTT CGT	1488
Ala Ile Ser Leu Ser Ala Ala Ala Gly Ile Gly Val Asp Asp Leu Arg	
485 490 495	
CGC TTA TGC ATA CTC AGG ATG AGT TTT GTG AAA GGC TGG GGA CCG GAT	1536
Arg Leu Cys Ile Leu Arg Met Ser Phe Val Lys Gly Trp Gly Pro Asp	
500 505 510	
TAC CCA AGA CAG AGC ATC AAA GAA ACA CCT TGC TGG ATT GAA ATT CAC	1584
Tyr Pro Arg Gln Ser Ile Lys Glu Thr Pro Cys Trp Ile Glu Ile His	
515 520 525	
TTA CAC CGG GCC CTC CAG CTC CTA GAC GAA GTA CTT CAT ACC ATG CCG	1632
Leu His Arg Ala Leu Gln Leu Leu Asp Glu Val Leu His Thr Met Pro	
530 535 540	
ATT GCA GAC CCA CAA CCT TTA GAC TGG GAT CCA CCG GTC GCC ACC ATG	1680
Ile Ala Asp Pro Gln Pro Leu Asp Trp Asp Pro Pro Val Ala Thr Met	
545 550 555 560	
GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG GTC	1728
Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val	
565 570 575	
GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC GAG	1776

Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu	
580 585 590	
GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC TGC	1824
Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys	
595 600 605	
ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC CTG	1872
Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu	
610 615 620	
ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG CAG	1920
Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln	
625 630 635 640	
CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC	1968
His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg	
645 650 655	
ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG	2016
Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val	
660 665 670	
AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC	2064
Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile	
675 680 685	
GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC	2112
Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn	
690 695 700	
TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC	2160
Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly	
705 710 715 720	
ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG	2208
Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val	
725 730 735	
CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC	2256
Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro	
740 745 750	
GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC	2304
Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser	
755 760 765	
AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG	2352
Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val	
770 775 780	
ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA	2397
Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys	
785 790 795	

(2) INFORMATION FOR SEQ ID NO:77:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 798 amino acids  
 (B) TYPE: amino acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:77:

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Met Asp Asn Met Ser Ile Thr Asn Thr Pro Thr Ser Asn Asp Ala Cys
 1           5           10          15
Leu Ser Ile Val His Ser Leu Met Cys His Arg Gln Gly Gly Glu Ser
          20          25          30
Glu Thr Phe Ala Lys Arg Ala Ile Glu Ser Leu Val Lys Lys Leu Lys
          35          40          45
Glu Lys Lys Asp Glu Leu Asp Ser Leu Ile Thr Ala Ile Thr Thr Asn
 50          55          60
Gly Ala His Pro Ser Lys Cys Val Thr Ile Gln Arg Thr Leu Asp Gly
 65          70          75          80
Arg Leu Gln Val Ala Gly Arg Lys Gly Phe Pro His Val Ile Tyr Ala
          85          90          95
Arg Leu Trp Arg Trp Pro Asp Leu His Lys Asn Glu Leu Lys His Val
          100         105         110
Lys Tyr Cys Gln Tyr Ala Phe Asp Leu Lys Cys Asp Ser Val Cys Val
          115         120         125
Asn Pro Tyr His Tyr Glu Arg Val Val Ser Pro Gly Ile Asp Leu Ser
 130         135         140
Gly Leu Thr Leu Gln Ser Asn Ala Pro Ser Ser Met Met Val Lys Asp
 145         150         155         160
Glu Tyr Val His Asp Phe Glu Gly Gln Pro Ser Leu Ser Thr Glu Gly
          165         170         175
His Ser Ile Gln Thr Ile Gln His Pro Pro Ser Asn Arg Ala Ser Thr
          180         185         190
Glu Thr Tyr Ser Thr Pro Ala Leu Leu Ala Pro Ser Glu Ser Asn Ala
          195         200         205
Thr Ser Thr Ala Asn Phe Pro Asn Ile Pro Val Ala Ser Thr Ser Gln
          210         215         220
Pro Ala Ser Ile Leu Gly Gly Ser His Ser Glu Gly Leu Leu Gln Ile
 225         230         235         240
Ala Ser Gly Pro Gln Pro Gly Gln Gln Asn Gly Phe Thr Gly Gln
          245         250         255
Pro Ala Thr Tyr His His Asn Ser Thr Thr Thr Trp Thr Gly Ser Arg
          260         265         270
Thr Ala Pro Tyr Thr Pro Asn Leu Pro His His Gln Asn Gly His Leu
          275         280         285
Gln His His Pro Pro Met Pro Pro His Pro Gly His Tyr Trp Pro Val
          290         295         300
His Asn Glu Leu Ala Phe Gln Pro Pro Ile Ser Asn His Pro Ala Pro
 305         310         315         320
Glu Tyr Trp Cys Ser Ile Ala Tyr Phe Glu Met Asp Val Gln Val Gly
          325         330         335
Glu Thr Phe Lys Val Pro Ser Ser Cys Pro Ile Val Thr Val Asp Gly
          340         345         350
Tyr Val Asp Pro Ser Gly Gly Asp Arg Phe Cys Leu Gly Gln Leu Ser
          355         360         365
Asn Val His Arg Thr Glu Ala Ile Glu Arg Ala Arg Leu His Ile Gly

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370		375		380
Lys Gly Val Gln Leu Glu Cys Lys Gly Glu Gly Asp Val Trp Val Arg				
385	390		395	400
Cys Leu Ser Asp His Ala Val Phe Val Gln Ser Tyr Tyr Leu Asp Arg				
	405		410	415
Glu Ala Gly Arg Ala Pro Gly Asp Ala Val His Lys Ile Tyr Pro Ser				
	420		425	430
Ala Tyr Ile Lys Val Phe Asp Leu Arg Gln Cys His Arg Gln Met Gln				
	435		440	445
Gln Gln Ala Ala Thr Ala Gln Ala Ala Ala Ala Gln Ala Ala Ala				
	450		455	460
Val Ala Gly Asn Ile Pro Gly Pro Gly Ser Val Gly Gly Ile Ala Pro				
465	470		475	480
Ala Ile Ser Leu Ser Ala Ala Ala Gly Ile Gly Val Asp Asp Leu Arg				
	485		490	495
Arg Leu Cys Ile Leu Arg Met Ser Phe Val Lys Gly Trp Gly Pro Asp				
	500		505	510
Tyr Pro Arg Gln Ser Ile Lys Glu Thr Pro Cys Trp Ile Glu Ile His				
	515		520	525
Leu His Arg Ala Leu Gln Leu Leu Asp Glu Val Leu His Thr Met Pro				
	530		535	540
Ile Ala Asp Pro Gln Pro Leu Asp Trp Asp Pro Pro Val Ala Thr Met				
545	550		555	560
Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val				
	565		570	575
Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu				
	580		585	590
Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys				
	595		600	605
Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu				
	610		615	620
Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln				
625	630		635	640
His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg				
	645		650	655
Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val				
	660		665	670
Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile				
	675		680	685
Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn				
	690		695	700
Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly				
705	710		715	720
Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val				
	725		730	735
Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro				
	740		745	750
Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser				
	755		760	765
Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val				
	770		775	780
Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys				
785	790		795	

## (2) INFORMATION FOR SEQ ID NO:78:

## (i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 3138 base pairs

(B) TYPE: nucleic acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA  
 (ix) FEATURE:

(A) NAME/KEY: Coding Sequence  
 (B) LOCATION: 1...3135  
 (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:78:

ATG GCG GGC TGG ATC CAG GCC CAG CAG CTG CAG GGA GAC GCG CTG CGC	48
Met Ala Gly Trp Ile Gln Ala Gln Gln Leu Gln Gly Asp Ala Leu Arg	
1 5 10 15	
CAG ATG CAG GTG CTG TAC GGC CAG CAC TTC CCC ATC GAG GTC CGG CAC	96
Gln Met Gln Val Leu Tyr Gly Gln His Phe Pro Ile Glu Val Arg His	
20 25 30	
TAC TTG GCC CAG TGG ATT GAG AGC CAG CCA TGG GAT GCC ATT GAC TTG	144
Tyr Leu Ala Gln Trp Ile Glu Ser Gln Pro Trp Asp Ala Ile Asp Leu	
35 40 45	
GAC AAT CCC CAG GAC AGA GCC CAA GCC ACC CAG CTC CTG GAG GGC CTG	192
Asp Asn Pro Gln Asp Arg Ala Gln Ala Thr Gln Leu Leu Glu Gly Leu	
50 55 60	
GTG CAG GAG CTG CAG AAG AAG GCG GAG CAC CAG GTG GGG GAA GAT GGG	240
Val Gln Glu Leu Gln Lys Lys Ala Glu His Gln Val Gly Glu Asp Gly	
65 70 75 80	
TTT TTA CTG AAG ATC AAG CTG GGG CAC TAC GCC ACG CAG CTC CAG AAA	288
Phe Leu Leu Lys Ile Lys Leu Gly His Tyr Ala Thr Gln Leu Gln Lys	
85 90 95	
ACA TAT GAC CGC TGC CCC CTG GAG CTG GTC CGC TGC ATC CGG CAC ATT	336
Thr Tyr Asp Arg Cys Pro Leu Glu Leu Val Arg Cys Ile Arg His Ile	
100 105 110	
CTG TAC AAT GAA CAG AGG CTG GTC CGA GAA GCC AAC AAT TGC AGC TCT	384
Leu Tyr Asn Glu Gln Arg Leu Val Arg Glu Ala Asn Asn Cys Ser Ser	
115 120 125	
CCG GCT GGG ATC CTG GTT GAC GCC ATG TCC CAG AAG CAC CTT CAG ATC	432
Pro Ala Gly Ile Leu Val Asp Ala Met Ser Gln Lys His Leu Gln Ile	
130 135 140	
AAC CAG ACA TTT GAG GAG CTG CGA CTG GTC ACG CAG GAC ACA GAG AAT	480
Asn Gln Thr Phe Glu Glu Leu Arg Leu Val Thr Gln Asp Thr Glu Asn	
145 150 155 160	
GAG CTG AAG AAA CTG CAG CAG ACT CAG GAG TAC TTC ATC ATC CAG TAC	528
Glu Leu Lys Lys Leu Gln Gln Thr Gln Glu Tyr Phe Ile Ile Gln Tyr	
165 170 175	
CAG GAG AGC CTG AGG ATC CAA GCT CAG TTT GCC CAG CTG GCC CAG CTG	576

Gln	Glu	Ser	Leu	Arg	Ile	Gln	Ala	Gln	Phe	Ala	Gln	Leu	Ala	Gln	Leu		
			180					185					190				
AGC	CCC	CAG	GAG	CGT	CTG	AGC	CGG	GAG	ACG	GCC	CTC	CAG	CAG	AAG	CAG	624	
Ser	Pro	Gln	Glu	Arg	Leu	Ser	Arg	Glu	Thr	Ala	Leu	Gln	Gln	Lys	Gln		
		195					200				205						
GTG	TCT	CTG	GAG	GCC	TGG	TTG	CAG	CGT	GAG	GCA	CAG	ACA	CTG	CAG	CAG	672	
Val	Ser	Leu	Glu	Ala	Trp	Leu	Gln	Arg	Glu	Ala	Gln	Thr	Leu	Gln	Gln		
		210				215					220						
TAC	CGC	GTG	GAG	CTG	GCC	GAG	AAG	CAC	CAG	AAG	ACC	CTG	CAG	CTG	CTG	720	
Tyr	Arg	Val	Glu	Leu	Ala	Glu	Lys	His	Gln	Lys	Thr	Leu	Gln	Leu	Leu		
		225			230					235				240			
CGG	AAG	CAG	CAG	ACC	ATC	ATC	CTG	GAT	GAC	GAG	CTG	ATC	CAG	TGG	AAG	768	
Arg	Lys	Gln	Gln	Thr	Ile	Ile	Leu	Asp	Asp	Glu	Leu	Ile	Gln	Trp	Lys		
				245				250						255			
CGG	CGG	CAG	CAG	CTG	GCC	GGG	AAC	GGC	GGG	CCC	CCC	GAG	GGC	AGC	CTG	816	
Arg	Arg	Gln	Gln	Leu	Ala	Gly	Asn	Gly	Gly	Pro	Pro	Glu	Gly	Ser	Leu		
				260				265						270			
GAC	GTG	CTA	CAG	TCC	TGG	TGT	GAG	AAG	TTG	GCC	GAG	ATC	ATC	TGG	CAG	864	
Asp	Val	Leu	Gln	Ser	Trp	Cys	Glu	Lys	Leu	Ala	Glu	Ile	Ile	Trp	Gln		
		275						280						285			
AAC	CGG	CAG	CAG	ATC	CGC	AGG	GCT	GAG	CAC	CTC	TGC	CAG	CAG	CTG	CCC	912	
Asn	Arg	Gln	Gln	Ile	Arg	Ala	Glu	His	Leu	Cys	Gln	Gln	Leu	Pro			
		290				295				300							
ATC	CCC	GGC	CCA	GTG	GAG	GAG	ATG	CTG	GCC	GAG	GTC	AAC	GCC	ACC	ATC	960	
Ile	Pro	Gly	Pro	Val	Glu	Glu	Met	Leu	Ala	Glu	Val	Asn	Ala	Thr	Ile		
		305			310					315				320			
ACG	GAC	ATT	ATC	TCA	GCC	CTG	GTG	ACC	AGC	ACA	TTC	ATC	ATT	GAG	AAG	1008	
Thr	Asp	Ile	Ile	Ser	Ala	Leu	Val	Thr	Ser	Thr	Phe	Ile	Ile	Glu	Lys		
				325					330					335			
CAG	CCT	CCT	CAG	GTC	CTG	AAG	ACC	CAG	ACC	AAG	TTT	GCA	GCC	ACC	GTA	1056	
Gln	Pro	Pro	Gln	Val	Leu	Lys	Thr	Gln	Thr	Lys	Phe	Ala	Ala	Thr	Val		
				340				345						350			
CGC	CTG	CTG	GTG	GGC	GGG	AAG	CTG	AAC	GTG	CAC	ATG	AAT	CCC	CCC	CAG	1104	
Arg	Leu	Leu	Val	Gly	Gly	Lys	Leu	Asn	Val	His	Met	Asn	Pro	Pro	Gln		
		355					360							365			
GTG	AAG	GCC	ACC	ATC	ATC	AGT	GAG	CAG	CAG	GCC	AAG	TCT	CTG	CTT	AAA	1152	
Val	Lys	Ala	Thr	Ile	Ile	Ser	Glu	Gln	Gln	Ala	Lys	Ser	Leu	Leu	Lys		
		370				375					380						
AAT	GAG	AAC	ACC	CGC	AAC	GAG	TGC	AGT	GGT	GAG	ATC	CTG	AAC	AAC	TGC	1200	
Asn	Glu	Asn	Thr	Arg	Asn	Glu	Cys	Ser	Gly	Glu	Ile	Leu	Asn	Asn	Cys		
		385			390					395				400			
TGC	GTG	ATG	GAG	TAC	CAC	CAA	GCC	ACG	GGC	ACC	CTC	AGT	GCC	CAC	TTC	1248	
Cys	Val	Met	Glu	Tyr	His	Gln	Ala	Thr	Gly	Thr	Leu	Ser	Ala	His	Phe		
				405					410					415			

AGG AAC ATG TCA CTG AAG AGG ATC AAG CGT GCT GAC CGG CGG GGT GCA	1296
Arg Asn Met Ser Leu Lys Arg Ile Lys Arg Ala Asp Arg Arg Gly Ala	
420 425 430	
GAG TCC GTG ACA GAG GAG AAG TTC ACA GTC CTG TTT GAG TCT CAG TTC	1344
Glu Ser Val Thr Glu Glu Lys Phe Thr Val Leu Phe Glu Ser Gln Phe	
435 440 445	
AGT GTT GGC AGC AAT GAG CTT GTG TTC CAG GTG AAG ACT CTG TCC CTA	1392
Ser Val Gly Ser Asn Glu Leu Val Phe Gln Val Lys Thr Leu Ser Leu	
450 455 460	
CCT GTG GTT GTC ATC GTC CAC GGC AGC CAG GAC CAC AAT GCC ACG GCT	1440
Pro Val Val Val Ile Val His Gly Ser Gln Asp His Asn Ala Thr Ala	
465 470 475 480	
ACT GTG CTG TGG GAC AAT GCC TTT GCT GAG CCG GGC AGG GTG CCA TTT	1488
Thr Val Leu Trp Asp Asn Ala Phe Ala Glu Pro Gly Arg Val Pro Phe	
485 490 495	
GCC GTG CCT GAC AAA GTG CTG TGG CCG CAG CTG TGT GAG GCG CTC AAC	1536
Ala Val Pro Asp Lys Val Leu Trp Pro Gln Leu Cys Glu Ala Leu Asn	
500 505 510	
ATG AAA TTC AAG GCC GAA GTG CAG AGC AAC CCG GGC CTG ACC AAG GAG	1584
Met Lys Phe Lys Ala Glu Val Gln Ser Asn Arg Gly Leu Thr Lys Glu	
515 520 525	
AAC CTC GTG TTC CTG GCG CAG AAA CTG TTC AAC AAC AGC AGC AGC CAC	1632
Asn Leu Val Phe Leu Ala Gln Lys Leu Phe Asn Asn Ser Ser Ser His	
530 535 540	
CTG GAG GAC TAC AGT GGC CTG TCC GTG TCC TGG TCC CAG TTC AAC AGG	1680
Leu Glu Asp Tyr Ser Gly Leu Ser Val Ser Trp Ser Gln Phe Asn Arg	
545 550 555 560	
GAG AAC TTG CCG GGC TGG AAC TAC ACC TTC TGG CAG TGG TTT GAC GGG	1728
Glu Asn Leu Pro Gly Trp Asn Tyr Thr Phe Trp Gln Trp Phe Asp Gly	
565 570 575	
GTG ATG GAG GTG TTG AAG AAG CAC CAC AAG CCC CAC TGG AAT GAT GGG	1776
Val Met Glu Val Leu Lys Lys His His Lys Pro His Trp Asn Asp Gly	
580 585 590	
GCC ATC CTA GGT TTT GTG AAT AAG CAA CAG GCC CAC GAC CTG CTC ATC	1824
Ala Ile Leu Gly Phe Val Asn Lys Gln Gln Ala His Asp Leu Leu Ile	
595 600 605	
AAC AAG CCC GAC GGG ACC TTC TTG TTG CGC TTT AGT GAC TCA GAA ATC	1872
Asn Lys Pro Asp Gly Thr Phe Leu Leu Arg Phe Ser Asp Ser Glu Ile	
610 615 620	
GGG GGC ATC ACC ATC GCC TGG AAG TTT GAC TCC CCG GAA CGC AAC CTG	1920
Gly Gly Ile Thr Ile Ala Trp Lys Phe Asp Ser Pro Glu Arg Asn Leu	
625 630 635 640	
TGG AAC CTG AAA CCA TTC ACC ACG CGG GAT TTC TCC ATC AGG TCC CTG	1968



Trp	Asn	Leu	Lys	Pro	Phe	Thr	Thr	Arg	Asp	Phe	Ser	Ile	Arg	Ser	Leu	
				645					650						655	
GCT	GAC	CGG	CTG	GGG	GAC	CTG	AGC	TAT	CTC	ATC	TAT	GTG	TTT	CCT	GAC	2016
Ala	Asp	Arg	Leu	Gly	Asp	Leu	Ser	Tyr	Leu	Ile	Tyr	Val	Phe	Pro	Asp	
			660					665				670				
CGC	CCC	AAG	GAT	GAG	GTC	TTC	TCC	AAG	TAC	TAC	ACT	CCT	GTG	CTG	GCT	2064
Arg	Pro	Lys	Asp	Glu	Val	Phe	Ser	Lys	Tyr	Tyr	Thr	Pro	Val	Leu	Ala	
			675					680				685				
AAA	GCT	GTT	GAT	GGA	TAT	GTG	AAA	CCA	CAG	ATC	AAG	CAA	GTG	GTC	CCT	2112
Lys	Ala	Val	Asp	Gly	Tyr	Val	Lys	Pro	Gln	Ile	Lys	Gln	Val	Val	Pro	
			690					695				700				
GAG	TTT	GTG	AAT	GCA	TCT	GCA	GAT	GCT	GGG	GGC	AGC	AGC	GCC	ACG	TAC	2160
Glu	Phe	Val	Asn	Ala	Ser	Ala	Asp	Ala	Gly	Gly	Ser	Ser	Ala	Thr	Tyr	
					710					715					720	
ATG	GAC	CAG	GCC	CCC	TCC	CCA	GCT	GTG	TGC	CCC	CAG	GCT	CCC	TAT	AAC	2208
Met	Asp	Gln	Ala	Pro	Ser	Pro	Ala	Val	Cys	Pro	Gln	Ala	Pro	Tyr	Asn	
				725					730					735		
ATG	TAC	CCA	CAG	AAC	CCT	GAC	CAT	GTA	CTC	GAT	CAG	GAT	GGA	GAA	TTC	2256
Met	Tyr	Pro	Gln	Asn	Pro	Asp	His	Val	Leu	Asp	Gln	Asp	Gly	Glu	Phe	
				740				745					750			
GAC	CTG	GAT	GAG	ACC	ATG	GAT	GTG	GCC	AGG	CAC	GTG	GAG	GAA	CTC	TTA	2304
Asp	Leu	Asp	Glu	Thr	Met	Asp	Val	Ala	Arg	His	Val	Glu	Glu	Leu	Leu	
			755					760				765				
CGC	CGA	CCA	ATG	GAC	AGT	CTT	GAC	TCC	CGC	CTC	TCG	CCC	CCT	GCC	GGT	2352
Arg	Arg	Pro	Met	Asp	Ser	Leu	Asp	Ser	Arg	Leu	Ser	Pro	Pro	Ala	Gly	
			770				775				780					
CTT	TTC	ACC	TCT	GCC	AGA	GGC	TCC	CTC	TCA	TGG	GTA	CCG	CGG	GCC	CGG	2400
Leu	Phe	Thr	Ser	Ala	Arg	Gly	Ser	Leu	Ser	Trp	Val	Pro	Arg	Ala	Arg	
					790					795					800	
GAT	CCA	CCG	GTC	GCC	ACC	ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	2448
Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	
				805					810					815		
GGG	GTG	GTG	CCC	ATC	CTG	GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	2496
Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	
			820					825					830			
AAG	TTC	AGC	GTG	TCC	GGC	GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	2544
Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	
			835				840					845				
CTG	ACC	CTG	AAG	TTC	ATC	TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	2592
Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	
			850				855				860					
CCC	ACC	CTC	GTG	ACC	ACC	CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	2640
Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	
			865				870				875				880	

TAC CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro 885 890 895	2688
GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn 900 905 910	2736
TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn 915 920 925	2784
CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu 930 935 940	2832
GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met 945 950 955 960	2880
GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His 965 970 975	2928
AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn 980 985 990	2976
ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu 995 1000 1005	3024
AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His 1010 1015 1020	3072
ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met 1025 1030 1035 1040	3120
GAC GAG CTG TAC AAG TAA Asp Glu Leu Tyr Lys 1045	3138

## (2) INFORMATION FOR SEQ ID NO:79:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1045 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:79:

Met Ala Gly Trp Ile Gln Ala Gln Gln Leu Gln Gly Asp Ala Leu Arg  
 1 5 10 15  
 Gln Met Gln Val Leu Tyr Gly Gln His Phe Pro Ile Glu Val Arg His  
 20 25 30  
 Tyr Leu Ala Gln Trp Ile Glu Ser Gln Pro Trp Asp Ala Ile Asp Leu  
 35 40 45  
 Asp Asn Pro Gln Asp Arg Ala Gln Ala Thr Gln Leu Leu Glu Gly Leu  
 50 55 60  
 Val Gln Glu Leu Gln Lys Lys Ala Glu His Gln Val Gly Glu Asp Gly  
 65 70 75 80  
 Phe Leu Leu Lys Ile Lys Leu Gly His Tyr Ala Thr Gln Leu Gln Lys  
 85 90 95  
 Thr Tyr Asp Arg Cys Pro Leu Glu Leu Val Arg Cys Ile Arg His Ile  
 100 105 110  
 Leu Tyr Asn Glu Gln Arg Leu Val Arg Glu Ala Asn Asn Cys Ser Ser  
 115 120 125  
 Pro Ala Gly Ile Leu Val Asp Ala Met Ser Gln Lys His Leu Gln Ile  
 130 135 140  
 Asn Gln Thr Phe Glu Glu Leu Arg Leu Val Thr Gln Asp Thr Glu Asn  
 145 150 155 160  
 Glu Leu Lys Lys Leu Gln Gln Thr Gln Glu Tyr Phe Ile Ile Gln Tyr  
 165 170 175  
 Gln Glu Ser Leu Arg Ile Gln Ala Gln Phe Ala Gln Leu Ala Gln Leu  
 180 185 190  
 Ser Pro Gln Glu Arg Leu Ser Arg Glu Thr Ala Leu Gln Gln Lys Gln  
 195 200 205  
 Val Ser Leu Glu Ala Trp Leu Gln Arg Glu Ala Gln Thr Leu Gln Gln  
 210 215 220  
 Tyr Arg Val Glu Leu Ala Glu Lys His Gln Lys Thr Leu Gln Leu Leu  
 225 230 235 240  
 Arg Lys Gln Gln Thr Ile Ile Leu Asp Asp Glu Leu Ile Gln Trp Lys  
 245 250 255  
 Arg Arg Gln Gln Leu Ala Gly Asn Gly Gly Pro Pro Glu Gly Ser Leu  
 260 265 270  
 Asp Val Leu Gln Ser Trp Cys Glu Lys Leu Ala Glu Ile Ile Trp Gln  
 275 280 285  
 Asn Arg Gln Gln Ile Arg Arg Ala Glu His Leu Cys Gln Gln Leu Pro  
 290 295 300  
 Ile Pro Gly Pro Val Glu Glu Met Leu Ala Glu Val Asn Ala Thr Ile  
 305 310 315 320  
 Thr Asp Ile Ile Ser Ala Leu Val Thr Ser Thr Phe Ile Ile Glu Lys  
 325 330 335  
 Gln Pro Pro Gln Val Leu Lys Thr Gln Thr Lys Phe Ala Ala Thr Val  
 340 345 350  
 Arg Leu Leu Val Gly Gly Lys Leu Asn Val His Met Asn Pro Pro Gln  
 355 360 365  
 Val Lys Ala Thr Ile Ile Ser Glu Gln Gln Ala Lys Ser Leu Leu Lys  
 370 375 380  
 Asn Glu Asn Thr Arg Asn Glu Cys Ser Gly Glu Ile Leu Asn Asn Cys  
 385 390 395 400  
 Cys Val Met Glu Tyr His Gln Ala Thr Gly Thr Leu Ser Ala His Phe  
 405 410 415  
 Arg Asn Met Ser Leu Lys Arg Ile Lys Arg Ala Asp Arg Arg Gly Ala  
 420 425 430  
 Glu Ser Val Thr Glu Glu Lys Phe Thr Val Leu Phe Glu Ser Gln Phe  
 435 440 445  
 Ser Val Gly Ser Asn Glu Leu Val Phe Gln Val Lys Thr Leu Ser Leu

450	455	460
Pro Val Val Val Ile Val His Gly Ser Gln Asp His Asn Ala Thr Ala		
465	470	475
Thr Val Leu Trp Asp Asn Ala Phe Ala Glu Pro Gly Arg Val Pro Phe		480
	485	490
Ala Val Pro Asp Lys Val Leu Trp Pro Gln Leu Cys Glu Ala Leu Asn		495
	500	505
Met Lys Phe Lys Ala Glu Val Gln Ser Asn Arg Gly Leu Thr Lys Glu		510
	515	520
Asn Leu Val Phe Leu Ala Gln Lys Leu Phe Asn Asn Ser Ser Ser His		525
	530	535
Leu Glu Asp Tyr Ser Gly Leu Ser Val Ser Trp Ser Gln Phe Asn Arg		540
545	550	555
Glu Asn Leu Pro Gly Trp Asn Tyr Thr Phe Trp Gln Trp Phe Asp Gly		560
	565	570
Val Met Glu Val Leu Lys Lys His His Lys Pro His Trp Asn Asp Gly		575
	580	585
Ala Ile Leu Gly Phe Val Asn Lys Gln Gln Ala His Asp Leu Leu Ile		590
	595	600
Asn Lys Pro Asp Gly Thr Phe Leu Leu Arg Phe Ser Asp Ser Glu Ile		605
	610	615
Gly Gly Ile Thr Ile Ala Trp Lys Phe Asp Ser Pro Glu Arg Asn Leu		620
625	630	635
Trp Asn Leu Lys Pro Phe Thr Thr Arg Asp Phe Ser Ile Arg Ser Leu		640
	645	650
Ala Asp Arg Leu Gly Asp Leu Ser Tyr Leu Ile Tyr Val Phe Pro Asp		655
	660	665
Arg Pro Lys Asp Glu Val Phe Ser Lys Tyr Tyr Thr Pro Val Leu Ala		670
	675	680
Lys Ala Val Asp Gly Tyr Val Lys Pro Gln Ile Lys Gln Val Val Pro		685
	690	695
Glu Phe Val Asn Ala Ser Ala Asp Ala Gly Gly Ser Ser Ala Thr Tyr		700
705	710	715
Met Asp Gln Ala Pro Ser Pro Ala Val Cys Pro Gln Ala Pro Tyr Asn		720
	725	730
Met Tyr Pro Gln Asn Pro Asp His Val Leu Asp Gln Asp Gly Glu Phe		735
	740	745
Asp Leu Asp Glu Thr Met Asp Val Ala Arg His Val Glu Glu Leu Leu		750
	755	760
Arg Arg Pro Met Asp Ser Leu Asp Ser Arg Leu Ser Pro Pro Ala Gly		765
	770	775
Leu Phe Thr Ser Ala Arg Gly Ser Leu Ser Trp Val Pro Arg Ala Arg		780
785	790	795
Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr		800
	805	810
Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His		815
	820	825
Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys		830
	835	840
Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp		845
	850	855
Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg		860
865	870	875
Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro		880
	885	890
Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn		895
	900	905
Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn		910

915                      920                      925  
 Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu  
 930                      935                      940  
 Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met  
 945                      950                      955                      960  
 Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His  
 965                      970                      975  
 Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn  
 980                      985                      990  
 Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu  
 995                      1000                      1005  
 Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His  
 1010                      1015                      1020  
 Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met  
 025                      1030                      1035                      1040  
 Asp Glu Leu Tyr Lys  
 1045

(2) INFORMATION FOR SEQ ID NO:80:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:80:

TGGGATCCTC AGGCCGTGCT GCTGGCCG

28

(2) INFORMATION FOR SEQ ID NO:81:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:81:

GTCTCGAGGG AGCATGGGCA CCTTGCG

27

(2) INFORMATION FOR SEQ ID NO:82:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:82:

TGGGATCCGA GAAGTCTATA TCCCATC

27

(2) INFORMATION FOR SEQ ID NO:83:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:83:

TGGGATCCTT AGAAGTCTAT ATCCCATC

28

## (2) INFORMATION FOR SEQ ID NO:84:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:84:

GTCTCGAGCC ATGAACGCCC CCGAGCGG

28

## (2) INFORMATION FOR SEQ ID NO:85:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:85:

GTGAATTCTC GTCTGATTTC TGGCAGGAGG

30

## (2) INFORMATION FOR SEQ ID NO:86:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:86:

GTGAATTCTT TACGTCTGAT TTCTGGCAGG

30

## (2) INFORMATION FOR SEQ ID NO:87:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 34 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:87:

GTCTCGAGCC ATGGACGAAC TGTCCCCCT CATC

34

(2) INFORMATION FOR SEQ ID NO:88:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:88:

GTGGATCCAA GGAGCTGATC TGA CTCAGCA G

31

(2) INFORMATION FOR SEQ ID NO:89:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 32 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:89:

GTGGATCCTT AGGAGCTGAT CTGACTCAGC AG

32

(2) INFORMATION FOR SEQ ID NO:90:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 32 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:90:

CCTCCTAAGC TTATCATGGA CCATTATGAT TC

32

(2) INFORMATION FOR SEQ ID NO:91:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 33 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:91:

CCTCCTGGAT CCCTGCCGAG GATGATGGTC CAG

33

## (2) INFORMATION FOR SEQ ID NO:92:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 45 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:92:

GGATGGAAGC TTCAATGGCT GCCATCCGA AGAACTGGT GATTG

45

## (2) INFORMATION FOR SEQ ID NO:93:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 45 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:93:

GGATGGGGAT CCTCACAAGA CAAGCAACC AGATTTTTC TTCCC

45

## (2) INFORMATION FOR SEQ ID NO:94:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 29 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:94:

GGGAAGCTTC CATGAGCGAG ACGGTCATC

29

## (2) INFORMATION FOR SEQ ID NO:95:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:95:

CCCGATCCT CAGGAGAAC CCCGCTTC

28

## (2) INFORMATION FOR SEQ ID NO:96:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single



(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:96:

GTGAATTCGA CCATGGAGCG GCCCCCGGGG

30

(2) INFORMATION FOR SEQ ID NO:97:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:97:

GTGGTACCCA TTCTGTTAAC CAACTCC

27

(2) INFORMATION FOR SEQ ID NO:98:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:98:

GTGGTACCTC ATTCTGTTAA CCAACTCC

28

(2) INFORMATION FOR SEQ ID NO:99:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:99:

GTCTCGAGAG ATGCTGTCCC GTGGGTGG

28

(2) INFORMATION FOR SEQ ID NO:100:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:100:

GTGAATTCGC TTCCTCTTGA GGGAACC

27

## (2) INFORMATION FOR SEQ ID NO:101:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 27 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:101:

GTGAATTCAC TTCCTCTTGA GGAACC

27

## (2) INFORMATION FOR SEQ ID NO:102:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 29 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:102:

GTCTCGAGCC ATGGAGAACT TCCAAAAGG

29

## (2) INFORMATION FOR SEQ ID NO:103:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 28 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:103:

GTGGATCCCA GAGTCGAAGA TGGGGTAC

28

## (2) INFORMATION FOR SEQ ID NO:104:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 29 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:104:

GTGGATCCTC AGAGTCGAAG ATGGGGTAC

29

## (2) INFORMATION FOR SEQ ID NO:105:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 30 base pairs
- (B) TYPE: nucleic acid

- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:105:

GTGAATTCGG CGATGCCAGA CCCC GCGGCG

30

(2) INFORMATION FOR SEQ ID NO:106:

- (i) SEQUENCE CHARACTERISTICS:
  - (A) LENGTH: 32 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:106:

GTGGATCCCA GGCACAGGCA GCCTCAGCCT TC

32

(2) INFORMATION FOR SEQ ID NO:107:

- (i) SEQUENCE CHARACTERISTICS:
  - (A) LENGTH: 33 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:107:

GTGGATCCTC AGGCACAGGC AGCCTCAGCC TTC

33

(2) INFORMATION FOR SEQ ID NO:108:

- (i) SEQUENCE CHARACTERISTICS:
  - (A) LENGTH: 2616 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2613
- (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:108:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG  
 Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu  
 1 5 10 15

48

GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC  
 Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly  
 20 25 30

96

GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile 35 40 45	144
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr 50 55 60	192
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys 65 70 75 80	240
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu 85 90 95	288
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu 100 105 110	336
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125	384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GCT CAA GCT TCG AAT TCG GCG ATG CCA GAC CCC Gly Leu Arg Ser Arg Ala Gln Ala Ser Asn Ser Ala Met Pro Asp Pro 245 250 255	768
GCG GCG CAC CTG CCC TTC TTC TAC GGC AGC ATC TCG CGT GCC GAG GCC	816

Ala Ala His Leu Pro Phe Phe Tyr Gly Ser Ile Ser Arg Ala Glu Ala	
260 265 270	
GAG GAG CAC CTG AAG CTG GCG GGC ATG GCG GAC GGG CTC TTC CTG CTG	864
Glu Glu His Leu Lys Leu Ala Gly Met Ala Asp Gly Leu Phe Leu Leu	
275 280 285	
CGC CAG TGC CTG CGC TCG CTG GGC GGC TAT GTG CTG TCG CTC GTG CAC	912
Arg Gln Cys Leu Arg Ser Leu Gly Gly Tyr Val Leu Ser Leu Val His	
290 295 300	
GAT GTG CGC TTC CAC CAC TTT CCC ATC GAG CGC CAG CTC AAC GGC ACC	960
Asp Val Arg Phe His His Phe Pro Ile Glu Arg Gln Leu Asn Gly Thr	
305 310 315 320	
TAC GCC ATT GCC GGC GGC AAA GCG CAC TGT GGA CCG GCA GAG CTC TGC	1008
Tyr Ala Ile Ala Gly Gly Lys Ala His Cys Gly Pro Ala Glu Leu Cys	
325 330 335	
GAG TTC TAC TCG CGC GAC CCC GAC GGG CTG CCC TGC AAC CTG CGC AAG	1056
Glu Phe Tyr Ser Arg Asp Pro Asp Gly Leu Pro Cys Asn Leu Arg Lys	
340 345 350	
CCG TGC AAC CGG CCG TCG GGC CTC GAG CCG CAG CCG GGG GTC TTC GAC	1104
Pro Cys Asn Arg Pro Ser Gly Leu Glu Pro Gln Pro Gly Val Phe Asp	
355 360 365	
TGC CTG CGA GAC GCC ATG GTG CGT GAC TAC GTG CGC CAG ACG TGG AAG	1152
Cys Leu Arg Asp Ala Met Val Arg Asp Tyr Val Arg Gln Thr Trp Lys	
370 375 380	
CTG GAG GGC GAG GCC CTG GAG CAG GCC ATC ATC AGC CAG GCC CCG CAG	1200
Leu Glu Gly Glu Ala Leu Glu Gln Ala Ile Ile Ser Gln Ala Pro Gln	
385 390 395 400	
GTG GAG AAG CTC ATT GCT ACG ACG GCC CAC GAG CGG ATG CCC TGG TAC	1248
Val Glu Lys Leu Ile Ala Thr Thr Ala His Glu Arg Met Pro Trp Tyr	
405 410 415	
CAC AGC AGC CTG ACG CGT GAG GAG GCC GAG CGC AAA CTT TAC TCT GGG	1296
His Ser Ser Leu Thr Arg Glu Glu Ala Glu Arg Lys Leu Tyr Ser Gly	
420 425 430	
GCG CAG ACC GAC GGC AAG TTC CTG CTG AGG CCG CGG AAG GAG CAG GGC	1344
Ala Gln Thr Asp Gly Lys Phe Leu Leu Arg Pro Arg Lys Glu Gln Gly	
435 440 445	
ACA TAC GCC CTG TCC CTC ATC TAT GGG AAG ACG GTG TAC CAC TAC CTC	1392
Thr Tyr Ala Leu Ser Leu Ile Tyr Gly Lys Thr Val Tyr His Tyr Leu	
450 455 460	
ATC AGC CAA GAC AAG GCG GGC AAG TAC TGC ATT CCC GAG GGC ACC AAG	1440
Ile Ser Gln Asp Lys Ala Gly Lys Tyr Cys Ile Pro Glu Gly Thr Lys	
465 470 475 480	
TTT GAC ACG CTC TGG CAG CTG GTG GAG TAT CTG AAG CTG AAG GCG GAC	1488
Phe Asp Thr Leu Trp Gln Leu Val Glu Tyr Leu Lys Leu Lys Ala Asp	
485 490 495	

GGG CTC ATC TAC TGC CTG AAG GAG GCC TGC CCC AAC AGC AGT GCC AGC	1536
Gly Leu Ile Tyr Cys Leu Lys Glu Ala Cys Pro Asn Ser Ser Ala Ser	
500 505 510	
AAC GCC TCA GGG GCT GCT GCT CCC ACA CTC CCA GCC CAC CCA TCC ACG	1584
Asn Ala Ser Gly Ala Ala Ala Pro Thr Leu Pro Ala His Pro Ser Thr	
515 520 525	
TTG ACT CAT CCT CAG AGA CGA ATC GAC ACC CTC AAC TCA GAT GGA TAC	1632
Leu Thr His Pro Gln Arg Arg Ile Asp Thr Leu Asn Ser Asp Gly Tyr	
530 535 540	
ACC CCT GAG CCA GCA CGC ATA ACG TCC CCA GAC AAA CCG CGG CCG ATG	1680
Thr Pro Glu Pro Ala Arg Ile Thr Ser Pro Asp Lys Pro Arg Pro Met	
545 550 555 560	
CCC ATG GAC ACG AGC GTG TAT GAG AGC CCC TAC AGC GAC CCA GAG GAG	1728
Pro Met Asp Thr Ser Val Tyr Glu Ser Pro Tyr Ser Asp Pro Glu Glu	
565 570 575	
CTC AAG GAC AAG AAG CTC TTC CTG AAG CGC GAT AAC CTC CTC ATA GCT	1776
Leu Lys Asp Lys Lys Leu Phe Leu Lys Arg Asp Asn Leu Leu Ile Ala	
580 585 590	
GAC ATT GAA CTT GGC TGC GGC AAC TTT GGC TCA GTG CGC CAG GGC GTG	1824
Asp Ile Glu Leu Gly Cys Gly Asn Phe Gly Ser Val Arg Gln Gly Val	
595 600 605	
TAC CGC ATG CGC AAG AAG CAG ATC GAC GTG GCC ATC AAG GTG CTG AAG	1872
Tyr Arg Met Arg Lys Lys Gln Ile Asp Val Ala Ile Lys Val Leu Lys	
610 615 620	
CAG GGC ACG GAG AAG GCA GAC ACG GAA GAG ATG ATG CGC GAG GCG CAG	1920
Gln Gly Thr Glu Lys Ala Asp Thr Glu Glu Met Met Arg Glu Ala Gln	
625 630 635 640	
ATC ATG CAC CAG CTG GAC AAC CCC TAC ATC GTG CGG CTC ATT GGC GTC	1968
Ile Met His Gln Leu Asp Asn Pro Tyr Ile Val Arg Leu Ile Gly Val	
645 650 655	
TGC CAG GCC GAG GCC CTC ATG CTG GTC ATG GAG ATG GCT GGG GGC GGG	2016
Cys Gln Ala Glu Ala Leu Met Leu Val Met Glu Met Ala Gly Gly Gly	
660 665 670	
CCG CTG CAC AAG TTC CTG GTC GGC AAG AGG GAG GAG ATC CCT GTG AGC	2064
Pro Leu His Lys Phe Leu Val Gly Lys Arg Glu Glu Ile Pro Val Ser	
675 680 685	
AAT GTG GCC GAG CTG CTG CAC CAG GTG TCC ATG GGG ATG AAG TAC CTG	2112
Asn Val Ala Glu Leu Leu His Gln Val Ser Met Gly Met Lys Tyr Leu	
690 695 700	
GAG GAG AAG AAC TTT GTG CAC CGT GAC CTG GCG GCC CGC AAC GTC CTG	2160
Glu Glu Lys Asn Phe Val His Arg Asp Leu Ala Ala Arg Asn Val Leu	
705 710 715 720	
CTG GTT AAC CGG CAC TAC GCC AAG ATC AGC GAC TTT GGC CTC TCC AAA	2208

Leu Val Asn Arg His Tyr Ala Lys Ile Ser Asp Phe Gly Leu Ser Lys	
725 730 735	
GCA CTG GGT GCC GAC GAC AGC TAC TAC ACT GCC CGC TCA GCA GGG AAG	2256
Ala Leu Gly Ala Asp Asp Ser Tyr Tyr Thr Ala Arg Ser Ala Gly Lys	
740 745 750	
TGG CCG CTC AAG TGG TAC GCA CCC GAA TGC ATC AAC TTC CGC AAG TTC	2304
Trp Pro Leu Lys Trp Tyr Ala Pro Glu Cys Ile Asn Phe Arg Lys Phe	
755 760 765	
TCC AGC CGC AGC GAT GTC TGG AGC TAT GGG GTC ACC ATG TGG GAG GCC	2352
Ser Ser Arg Ser Asp Val Trp Ser Tyr Gly Val Thr Met Trp Glu Ala	
770 775 780	
TTG TCC TAC GGC CAG AAG CCC TAC AAG AAG ATG AAA GGG CCG GAG GTC	2400
Leu Ser Tyr Gly Gln Lys Pro Tyr Lys Lys Met Lys Gly Pro Glu Val	
785 790 795 800	
ATG GCC TTC ATC GAG CAG GGC AAG CGG ATG GAG TGC CCA CCA GAG TGT	2448
Met Ala Phe Ile Glu Gln Gly Lys Arg Met Glu Cys Pro Pro Glu Cys	
805 810 815	
CCA CCC GAA CTG TAC GCA CTC ATG AGT GAC TGC TGG ATC TAC AAG TGG	2496
Pro Pro Glu Leu Tyr Ala Leu Met Ser Asp Cys Trp Ile Tyr Lys Trp	
820 825 830	
GAG GAT CGC CCC GAC TTC CTG ACC GTG GAG CAG CGC ATG CGA GCC TGT	2544
Glu Asp Arg Pro Asp Phe Leu Thr Val Glu Gln Arg Met Arg Ala Cys	
835 840 845	
TAC TAC AGC CTG GCC AGC AAG GTG GAA GGG CCC CCA GGC AGC ACA CAG	2592
Tyr Tyr Ser Leu Ala Ser Lys Val Glu Gly Pro Pro Gly Ser Thr Gln	
850 855 860	
AAG GCT GAG GCT GCC TGT GCC TGA	2616
Lys Ala Glu Ala Ala Cys Ala	
865 870	

## (2) INFORMATION FOR SEQ ID NO:109:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 871 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:109:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
1 5 10 15
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
20 25 30
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile

[illegible]



Asn	Ala	Ser	Gly	Ala	Ala	Ala	Pro	Thr	Leu	Pro	Ala	His	Pro	Ser	Thr
515							520					525			
Leu	Thr	His	Pro	Gln	Arg	Arg	Ile	Asp	Thr	Leu	Asn	Ser	Asp	Gly	Tyr
530							535					540			
Thr	Pro	Glu	Pro	Ala	Arg	Ile	Thr	Ser	Pro	Asp	Lys	Pro	Arg	Pro	Met
545					550					555					560
Pro	Met	Asp	Thr	Ser	Val	Tyr	Glu	Ser	Pro	Tyr	Ser	Asp	Pro	Glu	Glu
				565						570				575	
Leu	Lys	Asp	Lys	Lys	Leu	Phe	Leu	Lys	Arg	Asp	Asn	Leu	Leu	Ile	Ala
				580					585					590	
Asp	Ile	Glu	Leu	Gly	Cys	Gly	Asn	Phe	Gly	Ser	Val	Arg	Gln	Gly	Val
		595					600					605			
Tyr	Arg	Met	Arg	Lys	Lys	Gln	Ile	Asp	Val	Ala	Ile	Lys	Val	Leu	Lys
610						615					620				
Gln	Gly	Thr	Glu	Lys	Ala	Asp	Thr	Glu	Glu	Met	Met	Arg	Glu	Ala	Gln
625					630					635					640
Ile	Met	His	Gln	Leu	Asp	Asn	Pro	Tyr	Ile	Val	Arg	Leu	Ile	Gly	Val
				645					650					655	
Cys	Gln	Ala	Glu	Ala	Leu	Met	Leu	Val	Met	Glu	Met	Ala	Gly	Gly	Gly
				660					665				670		
Pro	Leu	His	Lys	Phe	Leu	Val	Gly	Lys	Arg	Glu	Glu	Ile	Pro	Val	Ser
		675					680					685			
Asn	Val	Ala	Glu	Leu	Leu	His	Gln	Val	Ser	Met	Gly	Met	Lys	Tyr	Leu
690						695					700				
Glu	Glu	Lys	Asn	Phe	Val	His	Arg	Asp	Leu	Ala	Ala	Arg	Asn	Val	Leu
705					710					715					720
Leu	Val	Asn	Arg	His	Tyr	Ala	Lys	Ile	Ser	Asp	Phe	Gly	Leu	Ser	Lys
				725						730				735	
Ala	Leu	Gly	Ala	Asp	Asp	Ser	Tyr	Tyr	Thr	Ala	Arg	Ser	Ala	Gly	Lys
			740						745				750		
Trp	Pro	Leu	Lys	Trp	Tyr	Ala	Pro	Glu	Cys	Ile	Asn	Phe	Arg	Lys	Phe
		755					760					765			
Ser	Ser	Arg	Ser	Asp	Val	Trp	Ser	Tyr	Gly	Val	Thr	Met	Trp	Glu	Ala
770						775					780				
Leu	Ser	Tyr	Gly	Gln	Lys	Pro	Tyr	Lys	Lys	Met	Lys	Gly	Pro	Glu	Val
785					790					795					800
Met	Ala	Phe	Ile	Glu	Gln	Gly	Lys	Arg	Met	Glu	Cys	Pro	Pro	Glu	Cys
				805					810					815	
Pro	Pro	Glu	Leu	Tyr	Ala	Leu	Met	Ser	Asp	Cys	Trp	Ile	Tyr	Lys	Trp
				820				825					830		
Glu	Asp	Arg	Pro	Asp	Phe	Leu	Thr	Val	Glu	Gln	Arg	Met	Arg	Ala	Cys
		835					840					845			
Tyr	Tyr	Ser	Leu	Ala	Ser	Lys	Val	Glu	Gly	Pro	Pro	Gly	Ser	Thr	Gln
850						855						860			
Lys	Ala	Glu	Ala	Ala	Cys	Ala									
865						870									

## (2) INFORMATION FOR SEQ ID NO:110:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2598 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

(A) NAME/KEY: Coding Sequence

(B) LOCATION: 1...2595

(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:110:

ATG CCA GAC CCC GCG GCG CAC CTG CCC TTC TTC TAC GGC AGC ATC TCG	48
Met Pro Asp Pro Ala Ala His Leu Pro Phe Phe Tyr Gly Ser Ile Ser	
1 5 10 15	
CGT GCC GAG GCC GAG GAG CAC CTG AAG CTG GCG GGC ATG GCG GAC GGG	96
Arg Ala Glu Ala Glu Glu His Leu Lys Leu Ala Gly Met Ala Asp Gly	
20 25 30	
CTC TTC CTG CTG CGC CAG TGC CTG CGC TCG CTG GGC GGC TAT GTG CTG	144
Leu Phe Leu Leu Arg Gln Cys Leu Arg Ser Leu Gly Gly Tyr Val Leu	
35 40 45	
TCG CTC GTG CAC GAT GTG CGC TTC CAC CAC TTT CCC ATC GAG CGC CAG	192
Ser Leu Val His Asp Val Arg Phe His His Phe Pro Ile Glu Arg Gln	
50 55 60	
CTC AAC GGC ACC TAC GCC ATT GCC GGC GGC AAA GCG CAC TGT GGA CCG	240
Leu Asn Gly Thr Tyr Ala Ile Ala Gly Gly Lys Ala His Cys Gly Pro	
65 70 75 80	
GCA GAG CTC TGC GAG TTC TAC TCG CGC GAC CCC GAC GGC CTG CCC TGC	288
Ala Glu Leu Cys Glu Phe Tyr Ser Arg Asp Pro Asp Gly Leu Pro Cys	
85 90 95	
AAC CTG CGC AAG CCG TGC AAC CGG CCG TCG GGC CTC GAG CCG CAG CCG	336
Asn Leu Arg Lys Pro Cys Asn Arg Pro Ser Gly Leu Glu Pro Gln Pro	
100 105 110	
GGG GTC TTC GAC TGC CTG CGA GAC GCC ATG GTG CGT GAC TAC GTG CGC	384
Gly Val Phe Asp Cys Leu Arg Asp Ala Met Val Arg Asp Tyr Val Arg	
115 120 125	
CAG ACG TGG AAG CTG GAG GGC GAG GCC CTG GAG CAG GCC ATC ATC AGC	432
Gln Thr Trp Lys Leu Glu Gly Glu Ala Leu Glu Gln Ala Ile Ile Ser	
130 135 140	
CAG GCC CCG CAG GTG GAG AAG CTC ATT GCT ACG ACG GCC CAC GAG CGG	480
Gln Ala Pro Gln Val Glu Lys Leu Ile Ala Thr Thr Ala His Glu Arg	
145 150 155 160	
ATG CCC TGG TAC CAC AGC AGC CTG ACG CGT GAG GAG GCC GAG CGC AAA	528
Met Pro Trp Tyr His Ser Ser Leu Thr Arg Glu Glu Ala Glu Arg Lys	
165 170 175	
CTT TAC TCT GGG GCG CAG ACC GAC GGC AAG TTC CTG CTG AGG CCG CGG	576
Leu Tyr Ser Gly Ala Gln Thr Asp Gly Lys Phe Leu Leu Arg Pro Arg	
180 185 190	
AAG GAG CAG GGC ACA TAC GCC CTG TCC CTC ATC TAT GGG AAG ACG GTG	624
Lys Glu Gln Gly Thr Tyr Ala Leu Ser Leu Ile Tyr Gly Lys Thr Val	
195 200 205	

TAC CAC TAC CTC ATC AGC CAA GAC AAG GCG GGC AAG TAC TGC ATT CCC	672
Tyr His Tyr Leu Ile Ser Gln Asp Lys Ala Gly Lys Tyr Cys Ile Pro	
210 215 220	
GAG GGC ACC AAG TTT GAC ACG CTC TGG CAG CTG GTG GAG TAT CTG AAG	720
Glu Gly Thr Lys Phe Asp Thr Leu Trp Gln Leu Val Glu Tyr Leu Lys	
225 230 235 240	
CTG AAG GCG GAC GGG CTC ATC TAC TGC CTG AAG GAG GCC TGC CCC AAC	768
Leu Lys Ala Asp Gly Leu Ile Tyr Cys Leu Lys Glu Ala Cys Pro Asn	
245 250 255	
AGC AGT GCC AGC AAC GCC TCA GGG GCT GCT GCT CCC ACA CTC CCA GCC	816
Ser Ser Ala Ser Asn Ala Ser Gly Ala Ala Ala Pro Thr Leu Pro Ala	
260 265 270	
CAC CCA TCC ACG TTG ACT CAT CCT CAG AGA CGA ATC GAC ACC CTC AAC	864
His Pro Ser Thr Leu Thr His Pro Gln Arg Arg Ile Asp Thr Leu Asn	
275 280 285	
TCA GAT GGA TAC ACC CCT GAG CCA GCA CGC ATA ACG TCC CCA GAC AAA	912
Ser Asp Gly Tyr Thr Pro Glu Pro Ala Arg Ile Thr Ser Pro Asp Lys	
290 295 300	
CCG CGG CCG ATG CCC ATG GAC ACG AGC GTG TAT GAG AGC CCC TAC AGC	960
Pro Arg Pro Met Pro Met Asp Thr Ser Val Tyr Glu Ser Pro Tyr Ser	
305 310 315 320	
GAC CCA GAG GAG CTC AAG GAC AAG AAG CTC TTC CTG AAG CGC GAT AAC	1008
Asp Pro Glu Glu Leu Lys Asp Lys Lys Leu Phe Leu Lys Arg Asp Asn	
325 330 335	
CTC CTC ATA GCT GAC ATT GAA CTT GGC TGC GGC AAC TTT GGC TCA GTG	1056
Leu Leu Ile Ala Asp Ile Glu Leu Gly Cys Gly Asn Phe Gly Ser Val	
340 345 350	
CGC CAG GGC GTG TAC CGC ATG CGC AAG AAG CAG ATC GAC GTG GCC ATC	1104
Arg Gln Gly Val Tyr Arg Met Arg Lys Lys Gln Ile Asp Val Ala Ile	
355 360 365	
AAG GTG CTG AAG CAG GGC ACG GAG AAG GCA GAC ACG GAA GAG ATG ATG	1152
Lys Val Leu Lys Gln Gly Thr Glu Lys Ala Asp Thr Glu Glu Met Met	
370 375 380	
CGC GAG GCG CAG ATC ATG CAC CAG CTG GAC AAC CCC TAC ATC GTG CGG	1200
Arg Glu Ala Gln Ile Met His Gln Leu Asp Asn Pro Tyr Ile Val Arg	
385 390 395 400	
CTC ATT GGC GTC TGC CAG GCC GAG GCC CTC ATG CTG GTC ATG GAG ATG	1248
Leu Ile Gly Val Cys Gln Ala Glu Ala Leu Met Leu Val Met Glu Met	
405 410 415	
GCT GGG GGC GGG CCG CTG CAC AAG TTC CTG GTC GGC AAG AGG GAG GAG	1296
Ala Gly Gly Gly Pro Leu His Lys Phe Leu Val Gly Lys Arg Glu Glu	
420 425 430	
ATC CCT GTG AGC AAT GTG GCC GAG CTG CTG CAC CAG GTG TCC ATG GGG	1344

Ile	Pro	Val	Ser	Asn	Val	Ala	Glu	Leu	Leu	His	Gln	Val	Ser	Met	Gly		
		435						440					445				
ATG	AAG	TAC	CTG	GAG	GAG	AAG	AAC	TTT	GTG	CAC	CGT	GAC	CTG	GCG	GCC	1392	
Met	Lys	Tyr	Leu	Glu	Glu	Lys	Asn	Phe	Val	His	Arg	Asp	Leu	Ala	Ala		
		450					455				460						
CGC	AAC	GTC	CTG	CTG	GTT	AAC	CGG	CAC	TAC	GCC	AAG	ATC	AGC	GAC	TTT	1440	
Arg	Asn	Val	Leu	Leu	Val	Asn	Arg	His	Tyr	Ala	Lys	Ile	Ser	Asp	Phe		
		465				470				475					480		
GGC	CTC	TCC	AAA	GCA	CTG	GGT	GCC	GAC	GAC	AGC	TAC	TAC	ACT	GCC	CGC	1488	
Gly	Leu	Ser	Lys	Ala	Leu	Gly	Ala	Asp	Asp	Ser	Tyr	Tyr	Thr	Ala	Arg		
				485					490					495			
TCA	GCA	GGG	AAG	TGG	CCG	CTC	AAG	TGG	TAC	GCA	CCC	GAA	TGC	ATC	AAC	1536	
Ser	Ala	Gly	Lys	Trp	Pro	Leu	Lys	Trp	Tyr	Ala	Pro	Glu	Cys	Ile	Asn		
			500					505					510				
TTC	CGC	AAG	TTC	TCC	AGC	CGC	AGC	GAT	GTC	TGG	AGC	TAT	GGG	GTC	ACC	1584	
Phe	Arg	Lys	Phe	Ser	Ser	Arg	Ser	Asp	Val	Trp	Ser	Tyr	Gly	Val	Thr		
		515					520					525					
ATG	TGG	GAG	GCC	TTG	TCC	TAC	GGC	CAG	AAG	CCC	TAC	AAG	AAG	ATG	AAA	1632	
Met	Trp	Glu	Ala	Leu	Ser	Tyr	Gly	Gln	Lys	Pro	Tyr	Lys	Lys	Met	Lys		
		530					535				540						
GGG	CCG	GAG	GTC	ATG	GCC	TTC	ATC	GAG	CAG	GGC	AAG	CGG	ATG	GAG	TGC	1680	
Gly	Pro	Glu	Val	Met	Ala	Phe	Ile	Glu	Gln	Gly	Lys	Arg	Met	Glu	Cys		
		545				550				555				560			
CCA	CCA	GAG	TGT	CCA	CCC	GAA	CTG	TAC	GCA	CTC	ATG	AGT	GAC	TGC	TGG	1728	
Pro	Pro	Glu	Cys	Pro	Pro	Glu	Leu	Tyr	Ala	Leu	Met	Ser	Asp	Cys	Trp		
				565					570					575			
ATC	TAC	AAG	TGG	GAG	GAT	CGC	CCC	GAC	TTC	CTG	ACC	GTG	GAG	CAG	CGC	1776	
Ile	Tyr	Lys	Trp	Glu	Asp	Arg	Pro	Asp	Phe	Leu	Thr	Val	Glu	Gln	Arg		
			580					585					590				
ATG	CGA	GCC	TGT	TAC	TAC	AGC	CTG	GCC	AGC	AAG	GTG	GAA	GGG	CCC	CCA	1824	
Met	Arg	Ala	Cys	Tyr	Tyr	Ser	Leu	Ala	Ser	Lys	Val	Glu	Gly	Pro	Pro		
		595					600					605					
GGC	AGC	ACA	CAG	AAG	GCT	GAG	GCT	GCC	TGT	GCC	TGG	GAT	CCA	CCG	GTC	1872	
Gly	Ser	Thr	Gln	Lys	Ala	Glu	Ala	Ala	Cys	Ala	Trp	Asp	Pro	Pro	Val		
		610				615					620						
GCC	ACC	ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	1920	
Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro		
		625				630				635				640			
ATC	CTG	GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	1968	
Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val		
				645				650					655				
TCC	GGC	GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	2016	
Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys		
			660					665					670				

TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG	2064
Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val	
675 680 685	
ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC	2112
Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His	
690 695 700	
ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC	2160
Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val	
705 710 715 720	
CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC	2208
Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg	
725 730 735	
GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG	2256
Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu	
740 745 750	
AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG	2304
Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu	
755 760 765	
GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG	2352
Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln	
770 775 780	
AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC	2400
Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp	
785 790 795 800	
GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC	2448
Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly	
805 810 815	
GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC	2496
Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser	
820 825 830	
GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG	2544
Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu	
835 840 845	
GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC	2592
Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr	
850 855 860	
AAG TAA	2598
Lys	
865	

(2) INFORMATION FOR SEQ ID NO:111:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 865 amino acids

(B) TYPE: amino acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein  
 (v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:111:

```

Met Pro Asp Pro Ala Ala His Leu Pro Phe Phe Tyr Gly Ser Ile Ser
 1           5           10           15
Arg Ala Glu Ala Glu Glu His Leu Lys Leu Ala Gly Met Ala Asp Gly
          20           25           30
Leu Phe Leu Leu Arg Gln Cys Leu Arg Ser Leu Gly Gly Tyr Val Leu
 35           40           45
Ser Leu Val His Asp Val Arg Phe His His Phe Pro Ile Glu Arg Gln
 50           55           60
Leu Asn Gly Thr Tyr Ala Ile Ala Gly Gly Lys Ala His Cys Gly Pro
 65           70           75           80
Ala Glu Leu Cys Glu Phe Tyr Ser Arg Asp Pro Asp Gly Leu Pro Cys
          85           90           95
Asn Leu Arg Lys Pro Cys Asn Arg Pro Ser Gly Leu Glu Pro Gln Pro
          100          105          110
Gly Val Phe Asp Cys Leu Arg Asp Ala Met Val Arg Asp Tyr Val Arg
          115          120          125
Gln Thr Trp Lys Leu Glu Gly Glu Ala Leu Glu Gln Ala Ile Ile Ser
          130          135          140
Gln Ala Pro Gln Val Glu Lys Leu Ile Ala Thr Thr Ala His Glu Arg
          145          150          155          160
Met Pro Trp Tyr His Ser Ser Leu Thr Arg Glu Glu Ala Glu Arg Lys
          165          170          175
Leu Tyr Ser Gly Ala Gln Thr Asp Gly Lys Phe Leu Leu Arg Pro Arg
          180          185          190
Lys Glu Gln Gly Thr Tyr Ala Leu Ser Leu Ile Tyr Gly Lys Thr Val
          195          200          205
Tyr His Tyr Leu Ile Ser Gln Asp Lys Ala Gly Lys Tyr Cys Ile Pro
          210          215          220
Glu Gly Thr Lys Phe Asp Thr Leu Trp Gln Leu Val Glu Tyr Leu Lys
          225          230          235          240
Leu Lys Ala Asp Gly Leu Ile Tyr Cys Leu Lys Glu Ala Cys Pro Asn
          245          250          255
Ser Ser Ala Ser Asn Ala Ser Gly Ala Ala Ala Pro Thr Leu Pro Ala
          260          265          270
His Pro Ser Thr Leu Thr His Pro Gln Arg Arg Ile Asp Thr Leu Asn
          275          280          285
Ser Asp Gly Tyr Thr Pro Glu Pro Ala Arg Ile Thr Ser Pro Asp Lys
          290          295          300
Pro Arg Pro Met Pro Met Asp Thr Ser Val Tyr Glu Ser Pro Tyr Ser
          305          310          315          320
Asp Pro Glu Glu Leu Lys Asp Lys Lys Leu Phe Leu Lys Arg Asp Asn
          325          330          335
Leu Leu Ile Ala Asp Ile Glu Leu Gly Cys Gly Asn Phe Gly Ser Val
          340          345          350
Arg Gln Gly Val Tyr Arg Met Arg Lys Lys Gln Ile Asp Val Ala Ile
          355          360          365
Lys Val Leu Lys Gln Gly Thr Glu Lys Ala Asp Thr Glu Glu Met Met
          370          375          380
Arg Glu Ala Gln Ile Met His Gln Leu Asp Asn Pro Tyr Ile Val Arg

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385		390		395		400									
Leu	Ile	Gly	Val	Cys	Gln	Ala	Glu	Ala	Leu	Met	Leu	Val	Met	Glu	Met
				405						410					415
Ala	Gly	Gly	Gly	Pro	Leu	His	Lys	Phe	Leu	Val	Gly	Lys	Arg	Glu	Glu
				420						425					430
Ile	Pro	Val	Ser	Asn	Val	Ala	Glu	Leu	Leu	His	Gln	Val	Ser	Met	Gly
				435						440					445
Met	Lys	Tyr	Leu	Glu	Glu	Lys	Asn	Phe	Val	His	Arg	Asp	Leu	Ala	Ala
				450						455					460
Arg	Asn	Val	Leu	Leu	Val	Asn	Arg	His	Tyr	Ala	Lys	Ile	Ser	Asp	Phe
				465						470					480
Gly	Leu	Ser	Lys	Ala	Leu	Gly	Ala	Asp	Asp	Ser	Tyr	Tyr	Thr	Ala	Arg
				485						490					495
Ser	Ala	Gly	Lys	Trp	Pro	Leu	Lys	Trp	Tyr	Ala	Pro	Glu	Cys	Ile	Asn
				500						505					510
Phe	Arg	Lys	Phe	Ser	Ser	Arg	Ser	Asp	Val	Trp	Ser	Tyr	Gly	Val	Thr
				515						520					525
Met	Trp	Glu	Ala	Leu	Ser	Tyr	Gly	Gln	Lys	Pro	Tyr	Lys	Lys	Met	Lys
				530						535					540
Gly	Pro	Glu	Val	Met	Ala	Phe	Ile	Glu	Gln	Gly	Lys	Arg	Met	Glu	Cys
				545						550					560
Pro	Pro	Glu	Cys	Pro	Pro	Glu	Leu	Tyr	Ala	Leu	Met	Ser	Asp	Cys	Trp
				565						570					575
Ile	Tyr	Lys	Trp	Glu	Asp	Arg	Pro	Asp	Phe	Leu	Thr	Val	Glu	Gln	Arg
				580						585					590
Met	Arg	Ala	Cys	Tyr	Tyr	Ser	Leu	Ala	Ser	Lys	Val	Glu	Gly	Pro	Pro
				595						600					605
Gly	Ser	Thr	Gln	Lys	Ala	Glu	Ala	Ala	Cys	Ala	Trp	Asp	Pro	Pro	Val
				610						615					620
Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro
				625						630					640
Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val
				645						650					655
Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys
				660						665					670
Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val
				675						680					685
Thr	Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His
				690						695					700
Met	Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val
				705						710					720
Gln	Glu	Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg
				725						730					735
Ala	Glu	Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu
				740						745					750
Lys	Gly	Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu
				755						760					765
Glu	Tyr	Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln
				770						775					780
Lys	Asn	Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp
				785						790					800
Gly	Ser	Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly
				805						810					815
Asp	Gly	Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser
				820						825					830
Ala	Leu	Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu
				835						840					845
Glu	Phe	Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr

850  
Lys  
865

855

860

(2) INFORMATION FOR SEQ ID NO:112:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1635 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1632
- (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:112:

ATG GAG AAC TTC CAA AAG GTG GAA AAG ATC GGA GAG GGC ACG TAC GGA	48
Met Glu Asn Phe Gln Lys Val Glu Lys Ile Gly Glu Gly Thr Tyr Gly	
1 5 10 15	
GTT GTG TAC AAA GCC AGA AAC AAG TTG ACG GGA GAG GTG GTG GCG CTT	96
Val Val Tyr Lys Ala Arg Asn Lys Leu Thr Gly Glu Val Val Ala Leu	
20 25 30	
AAG AAA ATC CGC CTG GAC ACT GAG ACT GAG GGT GTG CCC AGT ACT GCC	144
Lys Lys Ile Arg Leu Asp Thr Glu Thr Glu Gly Val Pro Ser Thr Ala	
35 40 45	
ATC CGA GAG ATC TCT CTG CTT AAG GAG CTT AAC CAT CCT AAT ATT GTC	192
Ile Arg Glu Ile Ser Leu Leu Lys Glu Leu Asn His Pro Asn Ile Val	
50 55 60	
AAG CTG CTG GAT GTC ATT CAC ACA GAA AAT AAA CTC TAC CTG GTT TTT	240
Lys Leu Leu Asp Val Ile His Thr Glu Asn Lys Leu Tyr Leu Val Phe	
65 70 75 80	
GAA TTT CTG CAC CAA GAT CTC AAG AAA TTC ATG GAT GCC TCT GCT CTC	288
Glu Phe Leu His Gln Asp Leu Lys Lys Phe Met Asp Ala Ser Ala Leu	
85 90 95	
ACT GGC ATT CCT CTT CCC CTC ATC AAG AGC TAT CTG TTC CAG CTG CTC	336
Thr Gly Ile Pro Leu Pro Leu Ile Lys Ser Tyr Leu Phe Gln Leu Leu	
100 105 110	
CAG GGC CTA GCT TTC TGC CAT TCT CAT CGG GTC CTC CAC CGA GAC CTT	384
Gln Gly Leu Ala Phe Cys His Ser His Arg Val Leu His Arg Asp Leu	
115 120 125	
AAA CCT CAG AAT CTG CTT ATT AAC ACA GAG GGG GCC ATC AAG CTA GCA	432
Lys Pro Gln Asn Leu Leu Ile Asn Thr Glu Gly Ala Ile Lys Leu Ala	
130 135 140	
GAC TTT GGA CTA GCC AGA GCT TTT GGA GTC CCT GTT CGT ACT TAC ACC	480



Asp	Phe	Gly	Leu	Ala	Arg	Ala	Phe	Gly	Val	Pro	Val	Arg	Thr	Tyr	Thr	
145					150					155					160	
CAT	GAG	GTG	GTG	ACC	CTG	TGG	TAC	CGA	GCT	CCT	GAA	ATC	CTC	CTG	GGC	528
His	Glu	Val	Val	Thr	Leu	Trp	Tyr	Arg	Ala	Pro	Glu	Ile	Leu	Leu	Gly	
				165					170					175		
TCG	AAA	TAT	TAT	TCC	ACA	GCT	GTG	GAC	ATC	TGG	AGC	CTG	GGC	TGC	ATC	576
Ser	Lys	Tyr	Tyr	Ser	Thr	Ala	Val	Asp	Ile	Trp	Ser	Leu	Gly	Cys	Ile	
			180					185					190			
TTT	GCT	GAG	ATG	GTG	ACT	CGC	CGG	GCC	CTG	TTC	CCT	GGA	GAT	TCT	GAG	624
Phe	Ala	Glu	Met	Val	Thr	Arg	Arg	Ala	Leu	Phe	Pro	Gly	Asp	Ser	Glu	
		195					200					205				
ATT	GAC	CAG	CTC	TTC	CGG	ATC	TTT	CGG	ACT	CTG	GGG	ACC	CCA	GAT	GAG	672
Ile	Asp	Gln	Leu	Phe	Arg	Ile	Phe	Arg	Thr	Leu	Gly	Thr	Pro	Asp	Glu	
	210					215					220					
GTG	GTG	TGG	CCA	GGA	GTT	ACT	TCT	ATG	CCT	GAT	TAC	AAG	CCA	AGT	TTC	720
Val	Val	Trp	Pro	Gly	Val	Thr	Ser	Met	Pro	Asp	Tyr	Lys	Pro	Ser	Phe	
225					230					235					240	
CCC	AAG	TGG	GCC	CGG	CAA	GAT	TTT	AGT	AAA	GTT	GTA	CCT	CCC	CTG	GAT	768
Pro	Lys	Trp	Ala	Arg	Gln	Asp	Phe	Ser	Lys	Val	Val	Pro	Pro	Leu	Asp	
			245						250					255		
GAA	GAT	GGA	CGG	AGC	TTG	TTA	TCG	CAA	ATG	CTG	CAC	TAC	GAC	CCT	AAC	816
Glu	Asp	Gly	Arg	Ser	Leu	Leu	Ser	Gln	Met	Leu	His	Tyr	Asp	Pro	Asn	
		260						265					270			
AAG	CGG	ATT	TCG	GCC	AAG	GCA	GCC	CTG	GCT	CAC	CCT	TTC	TTC	CAG	GAT	864
Lys	Arg	Ile	Ser	Ala	Lys	Ala	Ala	Leu	Ala	His	Pro	Phe	Phe	Gln	Asp	
		275					280					285				
GTG	ACC	AAG	CCA	GTA	CCC	CAT	CTT	CGA	CTC	TGG	GAT	CCA	CCG	GTC	GCC	912
Val	Thr	Lys	Pro	Val	Pro	His	Leu	Arg	Leu	Trp	Asp	Pro	Pro	Val	Ala	
		290				295					300					
ACC	ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	960
Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	
305					310					315				320		
CTG	GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	1008
Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	
			325						330					335		
GGC	GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	1056
Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	
			340					345					350			
ATC	TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	1104
Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	
		355					360					365				
ACC	CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	1152
Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	
	370					375						380				

AAG Lys 385	CAG Gln	CAC His	GAC Asp	TTC Phe	TTC Phe	AAG Lys	TCC Ser	GCC Ala	ATG Met	CCC Pro	GAA Glu	GGC Gly	TAC Tyr	GTC Val	CAG Gln	1200
390																
GAG Glu	CGC Arg	ACC Thr	ATC Ile	TTC Phe	TTC Phe	AAG Lys	GAC Asp	GAC Asp	GGC Gly	AAC Asn	TAC Tyr	AAG Lys	ACC Thr	CGC Arg	GCC Ala	1248
410																
GAG Glu	GTG Val	AAG Lys	TTC Phe	GAG Glu	GGC Gly	GAC Asp	ACC Thr	CTG Leu	GTG Val	AAC Asn	CGC Arg	ATC Ile	GAG Glu	CTG Leu	AAG Lys	1296
420																
GGC Gly	ATC Ile	GAC Asp	TTC Phe	AAG Lys	GAG Glu	GAC Asp	GGC Gly	AAC Asn	ATC Ile	CTG Leu	GGG Gly	CAC His	AAG Lys	CTG Leu	GAG Glu	1344
440																
TAC Tyr	AAC Asn	TAC Tyr	AAC Asn	AGC Ser	CAC His	AAC Asn	GTC Val	TAT Tyr	ATC Ile	ATG Met	GCC Ala	GAC Asp	AAG Lys	CAG Gln	AAG Lys	1392
450																
AAC Asn	GGC Gly	ATC Ile	AAG Lys	GTG Val	AAC Asn	TTC Phe	AAG Lys	ATC Ile	CGC Arg	CAC His	AAC Asn	ATC Ile	GAG Glu	GAC Asp	GGC Gly	1440
465																
AGC Ser	GTG Val	CAG Gln	CTC Leu	GCC Ala	GAC Asp	CAC His	TAC Tyr	CAG Gln	CAG Gln	AAC Asn	ACC Thr	CCC Pro	ATC Ile	GGC Gly	GAC Asp	1488
485																
GGC Gly	CCC Pro	GTG Val	CTG Leu	CTG Leu	CCC Pro	GAC Asp	AAC Asn	CAC His	TAC Tyr	CTG Leu	AGC Ser	ACC Thr	CAG Gln	TCC Ser	GCC Ala	1536
500																
CTG Leu	AGC Ser	AAA Lys	GAC Asp	CCC Pro	AAC Asn	GAG Glu	AAG Lys	CGC Arg	GAT Asp	CAC His	ATG Met	GTC Val	CTG Leu	CTG Leu	GAG Glu	1584
515																
TTC Phe	GTG Val	ACC Thr	GCC Ala	GCC Ala	GGG Gly	ATC Ile	ACT Thr	CTC Leu	GGC Gly	ATG Met	GAC Asp	GAG Glu	CTG Leu	TAC Tyr	AAG Lys	1633
530																
535																
540																
AA																
1635																

(2) INFORMATION FOR SEO ID NO:113:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 544 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:113:

Met Glu Asn Phe Gln Lys Val Glu Lys Ile Gly Glu Gly Thr Tyr Gly  
1 5 10 15

Val	Val	Tyr	Lys	Ala	Arg	Asn	Lys	Leu	Thr	Gly	Glu	Val	Val	Ala	Leu
			20					25					30		
Lys	Lys	Ile	Arg	Leu	Asp	Thr	Glu	Thr	Glu	Gly	Val	Pro	Ser	Thr	Ala
		35					40					45			
Ile	Arg	Glu	Ile	Ser	Leu	Leu	Lys	Glu	Leu	Asn	His	Pro	Asn	Ile	Val
		50					55				60				
Lys	Leu	Leu	Asp	Val	Ile	His	Thr	Glu	Asn	Lys	Leu	Tyr	Leu	Val	Phe
65					70					75					80
Glu	Phe	Leu	His	Gln	Asp	Leu	Lys	Lys	Phe	Met	Asp	Ala	Ser	Ala	Leu
				85					90					95	
Thr	Gly	Ile	Pro	Leu	Pro	Leu	Ile	Lys	Ser	Tyr	Leu	Phe	Gln	Leu	Leu
			100					105					110		
Gln	Gly	Leu	Ala	Phe	Cys	His	Ser	His	Arg	Val	Leu	His	Arg	Asp	Leu
			115				120					125			
Lys	Pro	Gln	Asn	Leu	Leu	Ile	Asn	Thr	Glu	Gly	Ala	Ile	Lys	Leu	Ala
						135					140				
Asp	Phe	Gly	Leu	Ala	Arg	Ala	Phe	Gly	Val	Pro	Val	Arg	Thr	Tyr	Thr
145					150					155					160
His	Glu	Val	Val	Thr	Leu	Trp	Tyr	Arg	Ala	Pro	Glu	Ile	Leu	Leu	Gly
				165						170				175	
Ser	Lys	Tyr	Tyr	Ser	Thr	Ala	Val	Asp	Ile	Trp	Ser	Leu	Gly	Cys	Ile
			180					185					190		
Phe	Ala	Glu	Met	Val	Thr	Arg	Arg	Ala	Leu	Phe	Pro	Gly	Asp	Ser	Glu
			195				200					205			
Ile	Asp	Gln	Leu	Phe	Arg	Ile	Phe	Arg	Thr	Leu	Gly	Thr	Pro	Asp	Glu
			210				215					220			
Val	Val	Trp	Pro	Gly	Val	Thr	Ser	Met	Pro	Asp	Tyr	Lys	Pro	Ser	Phe
225					230					235					240
Pro	Lys	Trp	Ala	Arg	Gln	Asp	Phe	Ser	Lys	Val	Val	Pro	Pro	Leu	Asp
				245					250					255	
Glu	Asp	Gly	Arg	Ser	Leu	Leu	Ser	Gln	Met	Leu	His	Tyr	Asp	Pro	Asn
			260					265					270		
Lys	Arg	Ile	Ser	Ala	Lys	Ala	Ala	Leu	Ala	His	Pro	Phe	Phe	Gln	Asp
		275					280					285			
Val	Thr	Lys	Pro	Val	Pro	His	Leu	Arg	Leu	Trp	Asp	Pro	Pro	Val	Ala
					295						300				
Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile
305					310						315				320
Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser
				325					330					335	
Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe
				340					345					350	
Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr
				355			360					365			
Thr	Leu	Thr	Tyr	Gly	Val	G									

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1635 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...1632  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:114:

ATG Met 1	GTG Val	AGC Ser	AAG Lys	GGC Gly 5	GAG Glu	GAG Glu	CTG Leu	TTC Phe	ACC Thr	GGG Gly	GTG Val	GTG Val	CCC Pro	ATC Ile	CTG Leu	48
GTC Val	GAG Glu	CTG Leu	GAC Asp	GGC Gly 20	GAC Asp	GTA Val	AAC Asn	GGC Gly 25	CAC His	AAG Lys	TTC Phe	AGC Ser	GTG Val	TCC Ser	GGC Gly	96
GAG Glu	GGC Gly	GAG Glu	GGC Gly	GAT Asp 35	GCC Ala	ACC Thr	TAC Tyr 40	GGC Gly	AAG Lys	CTG Leu	ACC Thr	CTG Leu	AAG Lys	TTC Phe	ATC Ile	144
TGC Cys	ACC Thr	ACC Thr	GGC Gly	AAG Lys	CTG Leu	CCC Pro	GTG Val	CCC Pro	TGG Trp	CCC Pro	ACC Thr	CTC Leu	GTG Val	ACC Thr	ACC Thr	192
CTG Leu 65	ACC Thr	TAC Tyr	GGC Gly	GTG Val	CAG Gln 70	TGC Cys	TTC Phe	AGC Ser	CGC Arg	TAC Tyr 75	CCC Pro	GAC Asp	CAC His	ATG Met	AAG Lys 80	240
CAG Gln	CAC His	GAC Asp	TTC Phe	TTC Phe 85	AAG Lys	TCC Ser	GCC Ala	ATG Met	CCC Pro	GAA Glu	GGC Gly	TAC Tyr	GTC Val	CAG Gln	GAG Glu	288
CGC Arg	ACC Thr	ATC Ile	TTC Phe 100	TTC Phe	AAG Lys	GAC Asp	GAC Asp	GGC Gly 105	AAC Asn	TAC Tyr	AAG Lys	ACC Thr	CGC Arg	GCC Ala	GAG Glu	336
GTG Val	AAG Lys	TTC Phe 115	GAG Glu	GGC Gly	GAC Asp	ACC Thr	CTG Leu 120	GTG Val	AAC Asn	CGC Arg	ATC Ile	GAG Glu 125	CTG Leu	AAG Lys	GGC Gly	384

ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GCC ATG GAG AAC TTC CAA AAG GTG GAA AAG ATC Gly Leu Arg Ser Arg Ala Met Glu Asn Phe Gln Lys Val Glu Lys Ile 245 250 255	768
GGA GAG GGC ACG TAC GGA GTT GTG TAC AAA GCC AGA AAC AAG TTG ACG Gly Glu Gly Thr Tyr Gly Val Val Tyr Lys Ala Arg Asn Lys Leu Thr 260 265 270	816
GGA GAG GTG GTG GCG CTT AAG AAA ATC CGC CTG GAC ACT GAG ACT GAG Gly Glu Val Val Ala Leu Lys Lys Ile Arg Leu Asp Thr Glu Thr Glu 275 280 285	864
GGT GTG CCC AGT ACT GCC ATC CGA GAG ATC TCT CTG CTT AAG GAG CTT Gly Val Pro Ser Thr Ala Ile Arg Glu Ile Ser Leu Leu Lys Glu Leu 290 295 300	912
AAC CAT CCT AAT ATT GTC AAG CTG CTG GAT GTC ATT CAC ACA GAA AAT Asn His Pro Asn Ile Val Lys Leu Leu Asp Val Ile His Thr Glu Asn 305 310 315 320	960
AAA CTC TAC CTG GTT TTT GAA TTT CTG CAC CAA GAT CTC AAG AAA TTC Lys Leu Tyr Leu Val Phe Glu Phe Leu His Gln Asp Leu Lys Lys Phe 325 330 335	1008
ATG GAT GCC TCT GCT CTC ACT GGC ATT CCT CTT CCC CTC ATC AAG AGC Met Asp Ala Ser Ala Leu Thr Gly Ile Pro Leu Pro Leu Ile Lys Ser 340 345 350	1056
TAT CTG TTC CAG CTG CTC CAG GGC CTA GCT TTC TGC CAT TCT CAT CGG Tyr Leu Phe Gln Leu Leu Gln Gly Leu Ala Phe Cys His Ser His Arg	1104

355	360	365	
GTC CTC CAC CGA GAC CTT AAA CCT CAG AAT CTG CTT ATT AAC ACA GAG			1152
Val Leu His Arg Asp Leu Lys Pro Gln Asn Leu Ile Asn Thr Glu			
370	375	380	
GGG GCC ATC AAG CTA GCA GAC TTT GGA CTA GCC AGA GCT TTT GGA GTC			1200
Gly Ala Ile Lys Leu Ala Asp Phe Gly Leu Ala Arg Ala Phe Gly Val			
385	390	395	400
CCT GTT CGT ACT TAC ACC CAT GAG GTG GTG ACC CTG TGG TAC CGA GCT			1248
Pro Val Arg Thr Tyr Thr His Glu Val Val Thr Leu Trp Tyr Arg Ala			
405	410		415
CCT GAA ATC CTC CTG GGC TCG AAA TAT TAT TCC ACA GCT GTG GAC ATC			1296
Pro Glu Ile Leu Leu Gly Ser Lys Tyr Tyr Ser Thr Ala Val Asp Ile			
420	425		430
TGG AGC CTG GGC TGC ATC TTT GCT GAG ATG GTG ACT CGC CGG GCC CTG			1344
Trp Ser Leu Gly Cys Ile Phe Ala Glu Met Val Thr Arg Arg Ala Leu			
435	440		445
TTC CCT GGA GAT TCT GAG ATT GAC CAG CTC TTC CGG ATC TTT CGG ACT			1392
Phe Pro Gly Asp Ser Glu Ile Asp Gln Leu Phe Arg Ile Phe Arg Thr			
450	455		460
CTG GGG ACC CCA GAT GAG GTG GTG TGG CCA GGA GTT ACT TCT ATG CCT			1440
Leu Gly Thr Pro Asp Glu Val Val Trp Pro Gly Val Thr Ser Met Pro			
465	470	475	480
GAT TAC AAG CCA AGT TTC CCC AAG TGG GCC CGG CAA GAT TTT AGT AAA			1488
Asp Tyr Lys Pro Ser Phe Pro Lys Trp Ala Arg Gln Asp Phe Ser Lys			
485	490		495
GTT GTA CCT CCC CTG GAT GAA GAT GGA CGG AGC TTG TTA TCG CAA ATG			1536
Val Val Pro Pro Leu Asp Glu Asp Gly Arg Ser Leu Leu Ser Gln Met			
500	505		510
CTG CAC TAC GAC CCT AAC AAG CGG ATT TCG GCC AAG GCA GCC CTG GCT			1584
Leu His Tyr Asp Pro Asn Lys Arg Ile Ser Ala Lys Ala Ala Leu Ala			
515	520		525
CAC CCT TTC TTC CAG GAT GTG ACC AAG CCA GTA CCC CAT CTT CGA CTC T			1633
His Pro Phe Phe Gln Asp Val Thr Lys Pro Val Pro His Leu Arg Leu			
530	535	540	
GA			1635

## (2) INFORMATION FOR SEQ ID NO:115:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 544 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:115:

```

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
 1          5          10          15
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
 20          25          30
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
 35          40          45
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
 50          55          60
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
 65          70          75          80
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu
 85          90          95
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu
100          105          110
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly
115          120          125
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr
130          135          140
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn
145          150          155          160
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser
165          170          175
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly
180          185          190
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu
195          200          205
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe
210          215          220
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser
225          230          235          240
Gly Leu Arg Ser Arg Ala Met Glu Asn Phe Gln Lys Val Glu Lys Ile
245          250          255
Gly Glu Gly Thr Tyr Gly Val Val Tyr Lys Ala Arg Asn Lys Leu Thr
260          265          270
Gly Glu Val Val Ala Leu Lys Lys Ile Arg Leu Asp Thr Glu Thr Glu
275          280          285
Gly Val Pro Ser Thr Ala Ile Arg Glu Ile Ser Leu Leu Lys Glu Leu
290          295          300
Asn His Pro Asn Ile Val Lys Leu Leu Asp Val Ile His Thr Glu Asn
305          310          315          320
Lys Leu Tyr Leu Val Phe Glu Phe Leu His Gln Asp Leu Lys Lys Phe
325          330          335
Met Asp Ala Ser Ala Leu Thr Gly Ile Pro Leu Pro Leu Ile Lys Ser
340          345          350
Tyr Leu Phe Gln Leu Leu Gln Gly Leu Ala Phe Cys His Ser His Arg
355          360          365
Val Leu His Arg Asp Leu Lys Pro Gln Asn Leu Leu Ile Asn Thr Glu
370          375          380
Gly Ala Ile Lys Leu Ala Asp Phe Gly Leu Ala Arg Ala Phe Gly Val
385          390          395          400
Pro Val Arg Thr Tyr Thr His Glu Val Val Thr Leu Trp Tyr Arg Ala
405          410          415
Pro Glu Ile Leu Leu Gly Ser Lys Tyr Tyr Ser Thr Ala Val Asp Ile
420          425          430
Trp Ser Leu Gly Cys Ile Phe Ala Glu Met Val Thr Arg Arg Ala Leu

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      435              440              445
Phe Pro Gly Asp Ser Glu Ile Asp Gln Leu Phe Arg Ile Phe Arg Thr
 450              455              460
Leu Gly Thr Pro Asp Glu Val Val Trp Pro Gly Val Thr Ser Met Pro
465              470              475              480
Asp Tyr Lys Pro Ser Phe Pro Lys Trp Ala Arg Gln Asp Phe Ser Lys
      485              490              495
Val Val Pro Pro Leu Asp Glu Asp Gly Arg Ser Leu Leu Ser Gln Met
      500              505              510
Leu His Tyr Asp Pro Asn Lys Arg Ile Ser Ala Lys Ala Ala Leu Ala
      515              520              525
His Pro Phe Phe Gln Asp Val Thr Lys Pro Val Pro His Leu Arg Leu
      530              535              540

```

## (2) INFORMATION FOR SEQ ID NO:116:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2532 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2529
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:116:

```

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG      48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
 1              5              10              15

GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC      96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
      20              25              30

GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC     144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
      35              40              45

TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC     192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
      50              55              60

CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG     240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
      65              70              75              80

CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG     288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu
      85              90              95

CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG     336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu
      100              105              110

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GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125	384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GAG ATG CTG TCC CGT GGG TGG TTT CAC CGA GAC Gly Leu Arg Ser Arg Glu Met Leu Ser Arg Gly Trp Phe His Arg Asp 245 250 255	768
CTC AGT GGG CTG GAT GCA GAG ACC CTG CTC AAG GGC CGA GGT GTC CAC Leu Ser Gly Leu Asp Ala Glu Thr Leu Leu Lys Gly Arg Gly Val His 260 265 270	816
GGT AGC TTC CTG GCT CGG CCC AGT CGC AAG AAC CAG GGT GAC TTC TCG Gly Ser Phe Leu Ala Arg Pro Ser Arg Lys Asn Gln Gly Asp Phe Ser 275 280 285	864
CTC TCC GTC AGG GTG GGG GAT CAG GTG ACC CAT ATT CGG ATC CAG AAC Leu Ser Val Arg Val Gly Asp Gln Val Thr His Ile Arg Ile Gln Asn 290 295 300	912
TCA GGG GAT TTC TAT GAC CTG TAT GGA GGG GAG AAG TTT GCG ACT CTG Ser Gly Asp Phe Tyr Asp Leu Tyr Gly Gly Glu Lys Phe Ala Thr Leu 305 310 315 320	960
ACA GAG CTG GTG GAG TAC TAC ACT CAG CAG CAG GGT GTC CTG CAG GAC Thr Glu Leu Val Glu Tyr Tyr Thr Gln Gln Gln Gly Val Leu Gln Asp 325 330 335	1008
CGC GAC GGC ACC ATC ATC CAC CTC AAG TAC CCG CTG AAC TGC TCC GAT	1056

Arg	Asp	Gly	Thr	Ile	Ile	His	Leu	Lys	Tyr	Pro	Leu	Asn	Cys	Ser	Asp		
			340					345					350				
CCC	ACT	AGT	GAG	AGG	TGG	TAC	CAT	GGC	CAC	ATG	TCT	GGC	GGG	CAG	GCA	1104	
Pro	Thr	Ser	Glu	Arg	Trp	Tyr	His	Gly	His	Met	Ser	Gly	Gly	Gln	Ala		
		355					360					365					
GAG	ACG	CTG	CTG	CAG	GCC	AAG	GGC	GAG	CCC	TGG	ACG	TTT	CTT	GTG	CGT	1152	
Glu	Thr	Leu	Leu	Gln	Ala	Lys	Gly	Glu	Pro	Trp	Thr	Phe	Leu	Val	Arg		
		370				375					380						
GAG	AGC	CTC	AGC	CAG	CCT	GGA	GAC	TTC	GTG	CTT	TCT	GTG	CTC	AGT	GAC	1200	
Glu	Ser	Leu	Ser	Gln	Pro	Gly	Asp	Phe	Val	Leu	Ser	Val	Leu	Ser	Asp		
385					390				395					400			
CAG	CCC	AAG	GCT	GGC	CCA	GGC	TCC	CCG	CTC	AGG	GTC	ACC	CAC	ATC	AAG	1248	
Gln	Pro	Lys	Ala	Gly	Pro	Gly	Ser	Pro	Leu	Arg	Val	Thr	His	Ile	Lys		
			405				410					415					
GTC	ATG	TGC	GAG	GGT	GGA	CGC	TAC	ACA	GTG	GGT	GGT	TTG	GAG	ACC	TTC	1296	
Val	Met	Cys	Glu	Gly	Gly	Arg	Tyr	Thr	Val	Gly	Gly	Leu	Glu	Thr	Phe		
			420			425						430					
GAC	AGC	CTC	ACG	GAC	CTG	GTA	GAG	CAT	TTC	AAG	AAG	ACG	GGG	ATT	GAG	1344	
Asp	Ser	Leu	Thr	Asp	Leu	Val	Glu	His	Phe	Lys	Lys	Thr	Gly	Ile	Glu		
		435				440						445					
GAG	GCC	TCA	GGC	GCC	TTT	GTC	TAC	CTG	CGG	CAG	CCG	TAC	TAT	GCC	ACG	1392	
Glu	Ala	Ser	Gly	Ala	Phe	Val	Tyr	Leu	Arg	Gln	Pro	Tyr	Tyr	Ala	Thr		
		450				455					460						
AGG	GTG	AAT	GCG	GCT	GAC	ATT	GAG	AAC	CGA	GTG	TTG	GAA	CTG	AAC	AAG	1440	
Arg	Val	Asn	Ala	Ala	Asp	Ile	Glu	Asn	Arg	Val	Leu	Glu	Leu	Asn	Lys		
465					470				475					480			
AAG	CAG	GAG	TCC	GAG	GAT	ACA	GCC	AAG	GCT	GGC	TTC	TGG	GAG	GAG	TTT	1488	
Lys	Gln	Glu	Ser	Glu	Asp	Thr	Ala	Lys	Ala	Gly	Phe	Trp	Glu	Glu	Phe		
			485					490					495				
GAG	AGT	TTG	CAG	AAG	CAG	GAG	GTG	AAG	AAC	TTG	CAC	CAG	CGT	CTG	GAA	1536	
Glu	Ser	Leu	Gln	Lys	Gln	Glu	Val	Lys	Asn	Leu	His	Gln	Arg	Leu	Glu		
		500					505					510					
GGG	CAG	CGG	CCA	GAG	AAC	AAG	GGC	AAG	AAC	CGC	TAC	AAG	AAC	ATT	CTC	1584	
Gly	Gln	Arg	Pro	Glu	Asn	Lys	Gly	Lys	Asn	Arg	Tyr	Lys	Asn	Ile	Leu		
		515				520						525					
CCC	TTT	GAC	CAC	AGC	CGA	GTG	ATC	CTG	CAG	GGA	CGG	GAC	AGT	AAC	ATC	1632	
Pro	Phe	Asp	His	Ser	Arg	Val	Ile	Leu	Gln	Gly	Arg	Asp	Ser	Asn	Ile		
		530				535					540						
CCC	GGG	TCC	GAC	TAC	ATC	AAT	GCC	AAC	TAC	ATC	AAG	AAC	CAG	CTG	CTA	1680	
Pro	Gly	Ser	Asp	Tyr	Ile	Asn	Ala	Asn	Tyr	Ile	Lys	Asn	Gln	Leu	Leu		
545					550				555					560			
GGC	CCT	GAT	GAG	AAC	GCT	AAG	ACC	TAC	ATC	GCC	AGC	CAG	GGC	TGT	CTG	1728	
Gly	Pro	Asp	Glu	Asn	Ala	Lys	Thr	Tyr	Ile	Ala	Ser	Gln	Gly	Cys	Leu		
			565					570					575				

GAG GCC ACG GTC AAT GAC TTC TGG CAG ATG GCG TGG CAG GAG AAC AGC	1776
Glu Ala Thr Val Asn Asp Phe Trp Gln Met Ala Trp Gln Glu Asn Ser	
580 585 590	
CGT GTC ATC GTC ATG ACC ACC CGA GAG GTG GAG AAA GGC CGG AAC AAA	1824
Arg Val Ile Val Met Thr Thr Arg Glu Val Glu Lys Gly Arg Asn Lys	
595 600 605	
TGC GTC CCA TAC TGG CCC GAG GTG GGC ATG CAG CGT GCT TAT GGG CCC	1872
Cys Val Pro Tyr Trp Pro Glu Val Gly Met Gln Arg Ala Tyr Gly Pro	
610 615 620	
TAC TCT GTG ACC AAC TGC GGG GAG CAT GAC ACA ACC GAA TAC AAA CTC	1920
Tyr Ser Val Thr Asn Cys Gly Glu His Asp Thr Thr Glu Tyr Lys Leu	
625 630 635 640	
CGT ACC TTA CAG GTC TCC CCG CTG GAC AAT GGA GAC CTG ATT CGG GAG	1968
Arg Thr Leu Gln Val Ser Pro Leu Asp Asn Gly Asp Leu Ile Arg Glu	
645 650 655	
ATC TGG CAT TAC CAG TAC CTG AGC TGG CCC GAC CAT GGG GTC CCC AGT	2016
Ile Trp His Tyr Gln Tyr Leu Ser Trp Pro Asp His Gly Val Pro Ser	
660 665 670	
GAG CCT GGG GGT GTC CTC AGC TTC CTG GAC CAG ATC AAC CAG CGG CAG	2064
Glu Pro Gly Gly Val Leu Ser Phe Leu Asp Gln Ile Asn Gln Arg Gln	
675 680 685	
GAA AGT CTG CCT CAC GCA GGG CCC ATC ATC GTG CAC TGC AGC GCC GGC	2112
Glu Ser Leu Pro His Ala Gly Pro Ile Ile Val His Cys Ser Ala Gly	
690 695 700	
ATC GGC CGC ACA GGC ACC ATC ATT GTC ATC GAC ATG CTC ATG GAG AAC	2160
Ile Gly Arg Thr Gly Thr Ile Ile Val Ile Asp Met Leu Met Glu Asn	
705 710 715 720	
ATC TCC ACC AAG GGC CTG GAC TGT GAC ATT GAC ATC CAG AAG ACC ATC	2208
Ile Ser Thr Lys Gly Leu Asp Cys Asp Ile Asp Ile Gln Lys Thr Ile	
725 730 735	
CAG ATG GTG CGG GCG CAG CGC TCG GGC ATG GTG CAG ACG GAG GCG CAG	2256
Gln Met Val Arg Ala Gln Arg Ser Gly Met Val Gln Thr Glu Ala Gln	
740 745 750	
TAC AAG TTC ATC TAC GTG GCC ATC GCC CAG TTC ATT GAA ACC ACT AAG	2304
Tyr Lys Phe Ile Tyr Val Ala Ile Ala Gln Phe Ile Glu Thr Thr Lys	
755 760 765	
AAG AAG CTG GAG GTC CTG CAG TCG CAG AAG GGC CAG GAG TCG GAG TAC	2352
Lys Lys Leu Glu Val Leu Gln Ser Gln Lys Gly Gln Glu Ser Glu Tyr	
770 775 780	
GGG AAC ATC ACC TAT CCC CCA GCC ATG AAG AAT GCC CAT GCC AAG GCC	2400
Gly Asn Ile Thr Tyr Pro Pro Ala Met Lys Asn Ala His Ala Lys Ala	
785 790 795 800	
TCC CGC ACC TCG TCC AAA CAC AAG GAG GAT GTG TAT GAG AAC CTG CAC	2448

Ser Arg Thr Ser Ser Lys His Lys Glu Asp Val Tyr Glu Asn Leu His  
805 810 815

ACT AAG AAC AAG AGG GAG GAG AAA GTG AAG AAG CAG CGG TCA GCA GAC 2496  
Thr Lys Asn Lys Arg Glu Glu Lys Val Lys Lys Gln Arg Ser Ala Asp  
820 825 830

AAG GAG AAG AGC AAG GGT TCC CTC AAG AGG AAG TGA 2532  
Lys Glu Lys Ser Lys Gly Ser Leu Lys Arg Lys  
835 840

(2) INFORMATION FOR SEQ ID NO:117:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 843 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:117:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu  
1 5 10 15  
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly  
20 25 30  
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile  
35 40 45  
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr  
50 55 60  
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys  
65 70 75 80  
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu  
85 90 95  
Arg Thr Ile Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu  
100 105 110  
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly  
115 120 125  
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr  
130 135 140  
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn  
145 150 155 160  
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser  
165 170 175  
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly  
180 185 190  
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu  
195 200 205  
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe  
210 215 220  
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser  
225 230 235 240  
Gly Leu Arg Ser Arg Glu Met Leu Ser Arg Gly Trp Phe His Arg Asp  
245 250 255  
Leu Ser Gly Leu Asp Ala Glu Thr Leu Leu Lys Gly Arg Gly Val His

										260				265				270			
Gly	Ser	Phe	Leu	Ala	Arg	Pro	Ser	Arg	Lys	Asn	Gln	Gly	Asp	Phe	Ser						
										275				280				285			
Leu	Ser	Val	Arg	Val	Gly	Asp	Gln	Val	Thr	His	Ile	Arg	Ile	Gln	Asn						
										290				295				300			
Ser	Gly	Asp	Phe	Tyr	Asp	Leu	Tyr	Gly	Gly	Glu	Lys	Phe	Ala	Thr	Leu						
										305				310				315			
Thr	Glu	Leu	Val	Glu	Tyr	Tyr	Thr	Gln	Gln	Gln	Gly	Val	Leu	Gln	Asp						
										320				325				330			
Arg	Asp	Gly	Thr	Ile	Ile	His	Leu	Lys	Tyr	Pro	Leu	Asn	Cys	Ser	Asp						
										335				340				345			
Pro	Thr	Ser	Glu	Arg	Trp	Tyr	His	Gly	His	Met	Ser	Gly	Gly	Gln	Ala						
										350				355				360			
Glu	Thr	Leu	Leu	Gln	Ala	Lys	Gly	Glu	Pro	Trp	Thr	Phe	Leu	Val	Arg						
										365				370				375			
Glu	Ser	Leu	Ser	Gln	Pro	Gly	Asp	Phe	Val	Leu	Ser	Val	Leu	Ser	Asp						
										380				385				390			
Gln	Pro	Lys	Ala	Gly	Pro	Gly	Ser	Pro	Leu	Arg	Val	Thr	His	Ile	Lys						
										395				400				405			
Val	Met	Cys	Glu	Gly	Gly	Arg	Tyr	Thr	Val	Gly	Gly	Leu	Glu	Thr	Phe						
										410				415				420			
Asp	Ser	Leu	Thr	Asp	Leu	Val	Glu	His	Phe	Lys	Lys	Thr	Gly	Ile	Glu						
										425				430				435			
Glu	Ala	Ser	Gly	Ala	Phe	Val	Tyr	Leu	Arg	Gln	Pro	Tyr	Tyr	Ala	Thr						
										440				445				450			
Arg	Val	Asn	Ala	Ala	Asp	Ile	Glu	Asn	Arg	Val	Leu	Glu	Leu	Asn	Lys						
										455				460				465			
Lys	Gln	Glu	Ser	Glu	Asp	Thr	Ala	Lys	Ala	Gly	Phe	Trp	Glu	Glu	Phe						
										470				475				480			
Glu	Ser	Leu	Gln	Lys	Gln	Glu	Val	Lys	Asn	Leu	His	Gln	Arg	Leu	Glu						
										485				490				495			
Gly	Gln	Arg	Pro	Glu	Asn	Lys	Gly	Lys	Asn	Arg	Tyr	Lys	Asn	Ile	Leu						
										500				505				510			
Pro	Phe	Asp	His	Ser	Arg	Val	Ile	Leu	Gln	Gly	Arg	Asp	Ser	Asn	Ile						
										515				520				525			
Pro	Gly	Ser	Asp	Tyr	Ile	Asn	Ala	Asn	Tyr	Ile	Lys	Asn	Gln	Leu	Leu						
										530				535				540			
Gly	Pro	Asp	Glu	Asn	Ala	Lys	Thr	Tyr	Ile	Ala	Ser	Gln	Gly	Cys	Leu						
										545				550				555			
Glu	Ala	Thr	Val	Asn	Asp	Phe	Trp	Gln	Met	Ala	Trp	Gln	Glu	Asn	Ser						
										560				565				570			
Arg	Val	Ile	Val	Met	Thr	Thr	Arg	Glu	Val	Glu	Lys	Gly	Arg	Asn	Lys						
										575				580				585			
Cys	Val	Pro	Tyr	Trp	Pro	Glu	Val	Gly	Met	Gln	Arg	Ala	Tyr	Gly	Pro						
										590				595				600			
Tyr	Ser	Val	Thr	Asn	Cys	Gly	Glu	His	Asp	Thr	Thr	Glu	Tyr	Lys	Leu						
										605				610				615			
Arg	Thr	Leu	Gln	Val	Ser	Pro	Leu	Asp	Asn	Gly	Asp	Leu	Ile	Arg	Glu						
										620				625				630			
Ile	Trp	His	Tyr	Gln	Tyr	Leu	Ser	Trp	Pro	Asp	His	Gly	Val								

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2562 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...2559  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:118:

ATG	CTG	TCC	CGT	GGG	TGG	TTT	CAC	CGA	GAC	CTC	AGT	GGG	CTG	GAT	GCA	48
Met	Leu	Ser	Arg	Gly	Trp	Phe	His	Arg	Asp	Leu	Ser	Gly	Leu	Asp	Ala	
1				5					10					15		
GAG	ACC	CTG	CTC	AAG	GGC	CGA	GGT	GTC	CAC	GGT	AGC	TTC	CTG	GCT	CGG	96
Glu	Thr	Leu	Leu	Lys	Gly	Arg	Gly	Val	His	Gly	Ser	Phe	Leu	Ala	Arg	
			20					25					30			
CCC	AGT	CGC	AAG	AAC	CAG	GGT	GAC	TTC	TCG	CTC	TCC	GTC	AGG	GTG	GGG	144
Pro	Ser	Arg	Lys	Asn	Gln	Gly	Asp	Phe	Ser	Leu	Ser	Val	Arg	Val	Gly	
		35					40					45				
GAT	CAG	GTG	ACC	CAT	ATT	CGG	ATC	CAG	AAC	TCA	GGG	GAT	TTC	TAT	GAC	192
Asp	Gln	Val	Thr	His	Ile	Arg	Ile	Gln	Asn	Ser	Gly	Asp	Phe	Tyr	Asp	
	50					55					60					
CTG	TAT	GGA	GGG	GAG	AAG	TTT	GCG	ACT	CTG	ACA	GAG	CTG	GTG	GAG	TAC	240
Leu	Tyr	Gly	Gly	Glu	Lys	Phe	Ala	Thr	Leu	Thr	Glu	Leu	Val	Glu	Tyr	
65				70					75					80		
TAC	ACT	CAG	CAG	CAG	GGT	GTC	CTG	CAG	GAC	CGC	GAC	GGC	ACC	ATC	ATC	288
Tyr	Thr	Gln	Gln	Gln	Gly	Val	Leu	Gln	Asp	Arg	Asp	Gly	Thr	Ile	Ile	
				85					90					95		
CAC	CTC	AAG	TAC	CCG	CTG	AAC	TGC	TCC	GAT	CCC	ACT	AGT	GAG	AGG	TGG	336

His	Leu	Lys	Tyr	Pro	Leu	Asn	Cys	Ser	Asp	Pro	Thr	Ser	Glu	Arg	Trp	
			100					105					110			
TAC	CAT	GGC	CAC	ATG	TCT	GGC	GGG	CAG	GCA	GAG	ACG	CTG	CTG	CAG	GCC	384
Tyr	His	Gly	His	Met	Ser	Gly	Gly	Gln	Ala	Glu	Thr	Leu	Leu	Gln	Ala	
		115					120					125				
AAG	GGC	GAG	CCC	TGG	ACG	TTT	CTT	GTG	CGT	GAG	AGC	CTC	AGC	CAG	CCT	432
Lys	Gly	Glu	Pro	Trp	Thr	Phe	Leu	Val	Arg	Glu	Ser	Leu	Ser	Gln	Pro	
	130						135				140					
GGA	GAC	TTC	GTG	CTT	TCT	GTG	CTC	AGT	GAC	CAG	CCC	AAG	GCT	GGC	CCA	480
Gly	Asp	Phe	Val	Leu	Ser	Val	Leu	Ser	Asp	Gln	Pro	Lys	Ala	Gly	Pro	
145						150				155					160	
GGC	TCC	CCG	CTC	AGG	GTC	ACC	CAC	ATC	AAG	GTC	ATG	TGC	GAG	GGT	GGA	528
Gly	Ser	Pro	Leu	Arg	Val	Thr	His	Ile	Lys	Val	Met	Cys	Glu	Gly	Gly	
				165					170					175		
CGC	TAC	ACA	GTG	GGT	GGT	TTG	GAG	ACC	TTC	GAC	AGC	CTC	ACG	GAC	CTG	576
Arg	Tyr	Thr	Val	Gly	Gly	Leu	Glu	Thr	Phe	Asp	Ser	Leu	Thr	Asp	Leu	
			180					185					190			
GTA	GAG	CAT	TTC	AAG	AAG	ACG	GGG	ATT	GAG	GAG	GCC	TCA	GGC	GCC	TTT	624
Val	Glu	His	Phe	Lys	Lys	Thr	Gly	Ile	Glu	Glu	Ala	Ser	Gly	Ala	Phe	
	195						200					205				
GTC	TAC	CTG	CGG	CAG	CCG	TAC	TAT	GCC	ACG	AGG	GTG	AAT	GCG	GCT	GAC	672
Val	Tyr	Leu	Arg	Gln	Pro	Tyr	Tyr	Ala	Thr	Arg	Val	Asn	Ala	Ala	Asp	
	210					215					220					
ATT	GAG	AAC	CGA	GTG	TTG	GAA	CTG	AAC	AAG	AAG	CAG	GAG	TCC	GAG	GAT	720
Ile	Glu	Asn	Arg	Val	Leu	Glu	Leu	Asn	Lys	Lys	Gln	Glu	Ser	Glu	Asp	
225					230					235					240	
ACA	GCC	AAG	GCT	GGC	TTC	TGG	GAG	GAG	TTT	GAG	AGT	TTG	CAG	AAG	CAG	768
Thr	Ala	Lys	Ala	Gly	Phe	Trp	Glu	Glu	Phe	Glu	Ser	Leu	Gln	Lys	Gln	
				245					250					255		
GAG	GTG	AAG	AAC	TTG	CAC	CAG	CGT	CTG	GAA	GGG	CAG	CGG	CCA	GAG	AAC	816
Glu	Val	Lys	Asn	Leu	His	Gln	Arg	Leu	Glu	Gly	Gln	Arg	Pro	Glu	Asn	
			260					265					270			
AAG	GGC	AAG	AAC	CGC	TAC	AAG	AAC	ATT	CTC	CCC	TTT	GAC	CAC	AGC	CGA	864
Lys	Gly	Lys	Asn	Arg	Tyr	Lys	Asn	Ile	Leu	Pro	Phe	Asp	His	Ser	Arg	
		275					280					285				
GTG	ATC	CTG	CAG	GGA	CGG	GAC	AGT	AAC	ATC	CCC	GGG	TCC	GAC	TAC	ATC	912
Val	Ile	Leu	Gln	Gly	Arg	Asp	Ser	Asn	Ile	Pro	Gly	Ser	Asp	Tyr	Ile	
	290					295					300					
AAT	GCC	AAC	TAC	ATC	AAG	AAC	CAG	CTG	CTA	GGC	CCT	GAT	GAG	AAC	GCT	960
Asn	Ala	Asn	Tyr	Ile	Lys	Asn	Gln	Leu	Leu	Gly	Pro	Asp	Glu	Asn	Ala	
305					310					315					320	
AAG	ACC	TAC	ATC	GCC	AGC	CAG	GGC	TGT	CTG	GAG	GCC	ACG	GTC	AAT	GAC	1008
Lys	Thr	Tyr	Ile	Ala	Ser	Gln	Gly	Cys	Leu	Glu	Ala	Thr	Val	Asn	Asp	
				325					330					335		

TTC TGG CAG ATG GCG TGG CAG GAG AAC AGC CGT GTC ATC GTC ATG ACC	1056
Phe Trp Gln Met Ala Trp Gln Glu Asn Ser Arg Val Ile Val Met Thr	
340 345 350	
ACC CGA GAG GTG GAG AAA GGC CGG AAC AAA TGC GTC CCA TAC TGG CCC	1104
Thr Arg Glu Val Glu Lys Gly Arg Asn Lys Cys Val Pro Tyr Trp Pro	
355 360 365	
GAG GTG GGC ATG CAG CGT GCT TAT GGG CCC TAC TCT GTG ACC AAC TGC	1152
Glu Val Gly Met Gln Arg Ala Tyr Gly Pro Tyr Ser Val Thr Asn Cys	
370 375 380	
GGG GAG CAT GAC ACA ACC GAA TAC AAA CTC CGT ACC TTA CAG GTC TCC	1200
Gly Glu His Asp Thr Thr Glu Tyr Lys Leu Arg Thr Leu Gln Val Ser	
385 390 395 400	
CCG CTG GAC AAT GGA GAC CTG ATT CGG GAG ATC TGG CAT TAC CAG TAC	1248
Pro Leu Asp Asn Gly Asp Leu Ile Arg Glu Ile Trp His Tyr Gln Tyr	
405 410 415	
CTG AGC TGG CCC GAC CAT GGG GTC CCC AGT GAG CCT GGG GGT GTC CTC	1296
Leu Ser Trp Pro Asp His Gly Val Pro Ser Glu Pro Gly Gly Val Leu	
420 425 430	
AGC TTC CTG GAC CAG ATC AAC CAG CGG CAG GAA AGT CTG CCT CAC GCA	1344
Ser Phe Leu Asp Gln Ile Asn Gln Arg Gln Glu Ser Leu Pro His Ala	
435 440 445	
GGG CCC ATC ATC GTG CAC TGC AGC GCC GGC ATC GGC CGC ACA GGC ACC	1392
Gly Pro Ile Ile Val His Cys Ser Ala Gly Ile Gly Arg Thr Gly Thr	
450 455 460	
ATC ATT GTC ATC GAC ATG CTC ATG GAG AAC ATC TCC ACC AAG GGC CTG	1440
Ile Ile Val Ile Asp Met Leu Met Glu Asn Ile Ser Thr Lys Gly Leu	
465 470 475 480	
GAC TGT GAC ATT GAC ATC CAG AAG ACC ATC CAG ATG GTG CGG GCG CAG	1488
Asp Cys Asp Ile Asp Ile Gln Lys Thr Ile Gln Met Val Arg Ala Gln	
485 490 495	
CGC TCG GGC ATG GTG CAG ACG GAG GCG CAG TAC AAG TTC ATC TAC GTG	1536
Arg Ser Gly Met Val Gln Thr Glu Ala Gln Tyr Lys Phe Ile Tyr Val	
500 505 510	
GCC ATC GCC CAG TTC ATT GAA ACC ACT AAG AAG AAG CTG GAG GTC CTG	1584
Ala Ile Ala Gln Phe Ile Glu Thr Thr Lys Lys Lys Leu Glu Val Leu	
515 520 525	
CAG TCG CAG AAG GGC CAG GAG TCG GAG TAC GGG AAC ATC ACC TAT CCC	1632
Gln Ser Gln Lys Gly Gln Glu Ser Glu Tyr Gly Asn Ile Thr Tyr Pro	
530 535 540	
CCA GCC ATG AAG AAT GCC CAT GCC AAG GCC TCC CGC ACC TCG TCC AAA	1680
Pro Ala Met Lys Asn Ala His Ala Lys Ala Ser Arg Thr Ser Ser Lys	
545 550 555 560	
CAC AAG GAG GAT GTG TAT GAG AAC CTG CAC ACT AAG AAC AAG AGG GAG	1728



His	Lys	Glu	Asp	Val	Tyr	Glu	Asn	Leu	His	Thr	Lys	Asn	Lys	Arg	Glu		
				565					570					575			
GAG	AAA	GTG	AAG	AAG	CAG	CGG	TCA	GCA	GAC	AAG	GAG	AAG	AGC	AAG	GGT	1776	
Glu	Lys	Val	Lys	Lys	Gln	Arg	Ser	Ala	Asp	Lys	Glu	Lys	Ser	Lys	Gly		
				580				585					590				
TCC	CTC	AAG	AGG	AAG	CGA	ATT	CTG	CAG	TCG	ACG	GTA	CCG	CGG	GCC	CGG	1824	
Ser	Leu	Lys	Arg	Lys	Arg	Ile	Leu	Gln	Ser	Thr	Val	Pro	Arg	Ala	Arg		
				595			600					605					
GAT	CCA	CCG	GTC	GCC	ACC	ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	1872	
Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr		
	610					615					620						
GGG	GTG	GTG	CCC	ATC	CTG	GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	1920	
Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His		
	625				630				635					640			
AAG	TTC	AGC	GTG	TCC	GGC	GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	1968	
Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys		
				645				650						655			
CTG	ACC	CTG	AAG	TTC	ATC	TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	2016	
Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp		
				660				665					670				
CCC	ACC	CTC	GTG	ACC	ACC	CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	2064	
Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg		
				675			680					685					
TAC	CCC	GAC	CAC	ATG	AAG	CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	2112	
Tyr	Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro		
	690					695					700						
GAA	GGC	TAC	GTC	CAG	GAG	CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	2160	
Glu	Gly	Tyr	Val	Gln	Glu	Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn		
	705				710				715					720			
TAC	AAG	ACC	CGC	GCC	GAG	GTG	AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	2208	
Tyr	Lys	Thr	Arg	Ala	Glu	Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn		
				725				730					735				
CGC	ATC	GAG	CTG	AAG	GGC	ATC	GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	CTG	2256	
Arg	Ile	Glu	Leu	Lys	Gly	Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu		
				740				745					750				
GGG	CAC	AAG	CTG	GAG	TAC	AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	2304	
Gly	His	Lys	Leu	Glu	Tyr	Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met		
				755			760					765					
GCC	GAC	AAG	CAG	AAG	AAC	GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	2352	
Ala	Asp	Lys	Gln	Lys	Asn	Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His		
	770					775					780						
AAC	ATC	GAG	GAC	GGC	AGC	GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	2400	
Asn	Ile	Glu	Asp	Gly	Ser	Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn		
	785					790				795					800		

ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG	2448
Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu	
805 810 815	
AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC	2496
Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His	
820 825 830	
ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG	2544
Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met	
835 840 845	
GAC GAG CTG TAC AAG TAA	2562
Asp Glu Leu Tyr Lys	
850	

## (2) INFORMATION FOR SEQ ID NO:119:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 853 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:119:

Met Leu Ser Arg Gly Trp Phe His Arg Asp Leu Ser Gly Leu Asp Ala	
1 5 10 15	
Glu Thr Leu Leu Lys Gly Arg Gly Val His Gly Ser Phe Leu Ala Arg	
20 25 30	
Pro Ser Arg Lys Asn Gln Gly Asp Phe Ser Leu Ser Val Arg Val Gly	
35 40 45	
Asp Gln Val Thr His Ile Arg Ile Gln Asn Ser Gly Asp Phe Tyr Asp	
50 55 60	
Leu Tyr Gly Gly Glu Lys Phe Ala Thr Leu Thr Glu Leu Val Glu Tyr	
65 70 75 80	
Tyr Thr Gln Gln Gln Gly Val Leu Gln Asp Arg Asp Gly Thr Ile Ile	
85 90 95	
His Leu Lys Tyr Pro Leu Asn Cys Ser Asp Pro Thr Ser Glu Arg Trp	
100 105 110	
Tyr His Gly His Met Ser Gly Gly Gln Ala Glu Thr Leu Leu Gln Ala	
115 120 125	
Lys Gly Glu Pro Trp Thr Phe Leu Val Arg Glu Ser Leu Ser Gln Pro	
130 135 140	
Gly Asp Phe Val Leu Ser Val Leu Ser Asp Gln Pro Lys Ala Gly Pro	
145 150 155 160	
Gly Ser Pro Leu Arg Val Thr His Ile Lys Val Met Cys Glu Gly Gly	
165 170 175	
Arg Tyr Thr Val Gly Gly Leu Glu Thr Phe Asp Ser Leu Thr Asp Leu	
180 185 190	
Val Glu His Phe Lys Lys Thr Gly Ile Glu Glu Ala Ser Gly Ala Phe	
195 200 205	
Val Tyr Leu Arg Gln Pro Tyr Tyr Ala Thr Arg Val Asn Ala Ala Asp	

210	215	220
Ile Glu Asn Arg Val	Leu Glu Leu Asn Lys	Lys Gln Glu Ser Glu Asp
225	230	235
Thr Ala Lys Ala Gly	Phe Trp Glu Glu Phe	Glu Ser Leu Gln Lys Gln
245	250	255
Glu Val Lys Asn Leu His	Gln Arg Leu Glu Gly	Gln Arg Pro Glu Asn
260	265	270
Lys Gly Lys Asn Arg Tyr	Lys Asn Ile Leu Pro	Phe Asp His Ser Arg
275	280	285
Val Ile Leu Gln Gly Arg	Asp Ser Asn Ile Pro	Gly Ser Asp Tyr Ile
290	295	300
Asn Ala Asn Tyr Ile Lys	Asn Gln Leu Leu Gly	Pro Asp Glu Asn Ala
305	310	315
Lys Thr Tyr Ile Ala Ser	Gln Gly Cys Leu Glu	Ala Thr Val Asn Asp
325	330	335
Phe Trp Gln Met Ala Trp	Gln Glu Asn Ser Arg	Val Ile Val Met Thr
340	345	350
Thr Arg Glu Val Glu Lys	Gly Arg Asn Lys Cys	Val Pro Tyr Trp Pro
355	360	365
Glu Val Gly Met Gln Arg	Ala Tyr Gly Pro Tyr	Ser Val Thr Asn Cys
370	375	380
Gly Glu His Asp Thr Thr	Glu Tyr Lys Leu Arg	Thr Leu Gln Val Ser
385	390	395
Pro Leu Asp Asn Gly Asp	Leu Ile Arg Glu Ile	Trp His Tyr Gln Tyr
405	410	415
Leu Ser Trp Pro Asp His	Gly Val Pro Ser Glu	Pro Gly Gly Val Leu
420	425	430
Ser Phe Leu Asp Gln Ile	Asn Gln Arg Gln Glu	Ser Leu Pro His Ala
435	440	445
Gly Pro Ile Ile Val His	Cys Ser Ala Gly Ile	Gly Arg Thr Gly Thr
450	455	460
Ile Ile Val Ile Asp Met	Leu Met Glu Asn Ile	Ser Thr Lys Gly Leu
465	470	475
Asp Cys Asp Ile Asp Ile	Gln Lys Thr Ile Gln	Met Val Arg Ala Gln
485	490	495
Arg Ser Gly Met Val Gln	Thr Glu Ala Gln Tyr	Lys Phe Ile Tyr Val
500	505	510
Ala Ile Ala Gln Phe Ile	Glu Thr Thr Lys Lys	Lys Leu Glu Val Leu
515	520	525
Gln Ser Gln Lys Gly Gln	Glu Ser Glu Tyr Gly	Asn Ile Thr Tyr Pro
530	535	540
Pro Ala Met Lys Asn Ala	His Ala Lys Ala Ser	Arg Thr Ser Ser Lys
545	550	555
His Lys Glu Asp Val Tyr	Glu Asn Leu His Thr	Lys Asn Lys Arg Glu
565	570	575
Glu Lys Val Lys Lys Gln	Arg Ser Ala Asp Lys	Glu Lys Ser Lys Gly
580	585	590
Ser Leu Lys Arg Lys Arg	Ile Leu Gln Ser Thr	Val Pro Arg Ala Arg
595	600	605
Asp Pro Pro Val Ala Thr	Met Val Ser Lys Gly	Glu Glu Leu Phe Thr
610	615	620
Gly Val Val Pro Ile Leu	Val Glu Leu Asp Gly	Asp Val Asn Gly His
625	630	635
Lys Phe Ser Val Ser Gly	Glu Gly Glu Gly Asp	Ala Thr Tyr Gly Lys
645	650	655
Leu Thr Leu Lys Phe Ile	Cys Thr Thr Gly Lys	Leu Pro Val Pro Trp
660	665	670
Pro Thr Leu Val Thr Thr	Leu Thr Tyr Gly Val	Gln Cys Phe Ser Arg

675	680	685
Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro		
690	695	700
Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn		
705	710	715
Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn		
725	730	735
Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu		
740	745	750
Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met		
755	760	765
Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His		
770	775	780
Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn		
785	790	795
Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu		
805	810	815
Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His		
820	825	830
Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met		
835	840	845
Asp Glu Leu Tyr Lys		
850		

## (2) INFORMATION FOR SEQ ID NO:120:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2994 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2991
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:120:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240

Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	
65					70					75					80	
CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	288
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	
			85						90					95		
CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	AAG	ACC	CGC	GCC	GAG	336
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	
			100					105					110			
GTG	AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	CGC	ATC	GAG	CTG	AAG	GGC	384
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	
		115					120					125				
ATC	GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	CTG	GGG	CAC	AAG	CTG	GAG	TAC	432
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	
		130				135					140					
AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	GCC	GAC	AAG	CAG	AAG	AAC	480
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	
		145			150					155					160	
GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	AAC	ATC	GAG	GAC	GGC	AGC	528
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	
			165					170						175		
GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	ACC	CCC	ATC	GGC	GAC	GGC	576
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	
			180				185						190			
CCC	GTG	CTG	CTG	CCC	GAC	AAC	CAC	TAC	CTG	AGC	ACC	CAG	TCC	GCC	CTG	624
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	
		195					200					205				
AGC	AAA	GAC	CCC	AAC	GAG	AAG	CGC	GAT	CAC	ATG	GTC	CTG	CTG	GAG	TTC	672
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	
		210				215				220						
GTG	ACC	GCC	GCC	GGG	ATC	ACT	CTC	GGC	ATG	GAC	GAG	CTG	TAC	AAG	TCC	720
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	
		225			230				235					240		
GGA	CTC	AGA	TCT	CGA	GCT	CAA	GCT	TCG	AAT	TCG	ACC	ATG	GAG	CGG	CCC	768
Gly	Leu	Arg	Ser	Arg	Ala	Gln	Ala	Ser	Asn	Ser	Thr	Met	Glu	Arg	Pro	
			245					250						255		
CCG	GGG	CTG	CGG	CCG	GGC	GCG	GGC	GGG	CCC	TGG	GAG	ATG	CGG	GAG	CGG	816
Pro	Gly	Leu	Arg	Pro	Gly	Ala	Gly	Gly	Pro	Trp	Glu	Met	Arg	Glu	Arg	
			260				265						270			
CTG	GGC	ACC	GGC	GGC	TTC	GGG	AAC	GTC	TGT	CTG	TAC	CAG	CAT	CGG	GAA	864
Leu	Gly	Thr	Gly	Gly	Phe	Gly	Asn	Val	Cys	Leu	Tyr	Gln	His	Arg	Glu	
		275					280					285				
CTT	GAT	CTC	AAA	ATA	GCA	ATT	AAG	TCT	TGT	CGC	CTA	GAG	CTA	AGT	ACC	912
Leu	Asp	Leu	Lys	Ile	Ala	Ile	Lys	Ser	Cys	Arg	Leu	Glu	Leu	Ser	Thr	
		290				295				300						



Gln	Leu	Met	Leu	Asn	Trp	Asp	Pro	Gln	Gln	Arg	Gly	Gly	Pro	Val	Asp		
530						535					540						
CTT	ACT	TTG	AAG	CAG	CCA	AGA	TGT	TTT	GTA	TTA	ATG	GAT	CAC	ATT	TTG	1680	
Leu	Thr	Leu	Lys	Gln	Pro	Arg	Cys	Phe	Val	Leu	Met	Asp	His	Ile	Leu		
545					550					555					560		
AAT	TTG	AAG	ATA	GTA	CAC	ATC	CTA	AAT	ATG	ACT	TCT	GCA	AAG	ATA	ATT	1728	
Asn	Leu	Lys	Ile	Val	His	Ile	Leu	Asn	Met	Thr	Ser	Ala	Lys	Ile	Ile		
				565				570						575			
TCT	TTT	CTG	TTA	CCA	CCT	GAT	GAA	AGT	CTT	CAT	TCA	CTA	CAG	TCT	CGT	1776	
Ser	Phe	Leu	Leu	Pro	Pro	Asp	Glu	Ser	Leu	His	Ser	Leu	Gln	Ser	Arg		
				580				585					590				
ATT	GAG	CGT	GAA	ACT	GGA	ATA	AAT	ACT	GGT	TCT	CAA	GAA	CTT	CTT	TCA	1824	
Ile	Glu	Arg	Glu	Thr	Gly	Ile	Asn	Thr	Gly	Ser	Gln	Glu	Leu	Leu	Ser		
		595					600					605					
GAG	ACA	GGA	ATT	TCT	CTG	GAT	CCT	CGG	AAA	CCA	GCC	TCT	CAA	TGT	GTT	1872	
Glu	Thr	Gly	Ile	Ser	Leu	Asp	Pro	Arg	Lys	Pro	Ala	Ser	Gln	Cys	Val		
		610				615					620						
CTA	GAT	GGA	GTT	AGA	GGC	TGT	GAT	AGC	TAT	ATG	GTT	TAT	TTG	TTT	GAT	1920	
Leu	Asp	Gly	Val	Arg	Gly	Cys	Asp	Ser	Tyr	Met	Val	Tyr	Leu	Phe	Asp		
625					630					635					640		
AAA	AGT	AAA	ACT	GTA	TAT	GAA	GGG	CCA	TTT	GCT	TCC	AGA	AGT	TTA	TCT	1968	
Lys	Ser	Lys	Thr	Val	Tyr	Glu	Gly	Pro	Phe	Ala	Ser	Arg	Ser	Leu	Ser		
				645				650						655			
GAT	TGT	GTA	AAT	TAT	ATT	GTA	CAG	GAC	AGC	AAA	ATA	CAG	CTT	CCA	ATT	2016	
Asp	Cys	Val	Asn	Tyr	Ile	Val	Gln	Asp	Ser	Lys	Ile	Gln	Leu	Pro	Ile		
			660					665					670				
ATA	CAG	CTG	CGT	AAA	GTG	TGG	GCT	GAA	GCA	GTG	CAC	TAT	GTG	TCT	GGA	2064	
Ile	Gln	Leu	Arg	Lys	Val	Trp	Ala	Glu	Ala	Val	His	Tyr	Val	Ser	Gly		
			675				680					685					
CTA	AAA	GAA	GAC	TAT	AGC	AGG	CTC	TTT	CAG	GGA	CAA	AGG	GCA	GCA	ATG	2112	
Leu	Lys	Glu	Asp	Tyr	Ser	Arg	Leu	Phe	Gln	Gly	Gln	Arg	Ala	Ala	Met		
		690				695					700						
TTA	AGT	CTT	CTT	AGA	TAT	AAT	GCT	AAC	TTA	ACA	AAA	ATG	AAG	AAC	ACT	2160	
Leu	Ser	Leu	Leu	Arg	Tyr	Asn	Ala	Asn	Leu	Thr	Lys	Met	Lys	Asn	Thr		
705					710					715					720		
TTG	ATC	TCA	GCA	TCA	CAA	CAA	CTG	AAA	GCT	AAA	TTG	GAG	TTT	TTT	CAC	2208	
Leu	Ile	Ser	Ala	Ser	Gln	Gln	Leu	Lys	Ala	Lys	Leu	Glu	Phe	Phe	His		
				725				730					735				
AAA	AGC	ATT	CAG	CTT	GAC	TTG	GAG	AGA	TAC	AGC	GAG	CAG	ATG	ACG	TAT	2256	
Lys	Ser	Ile	Gln	Leu	Asp	Leu	Glu	Arg	Tyr	Ser	Glu	Gln	Met	Thr	Tyr		
			740					745					750				
GGG	ATA	TCT	TCA	GAA	AAA	ATG	CTA	AAA	GCA	TGG	AAA	GAA	ATG	GAA	GAA	2304	
Gly	Ile	Ser	Ser	Glu	Lys	Met	Leu	Lys	Ala	Trp	Lys	Glu	Met	Glu	Glu		
			755				760					765					

AAG GCC ATC CAC TAT GCT GAG GTT GGT GTC ATT GGA TAC CTG GAG GAT Lys Ala Ile His Tyr Ala Glu Val Gly Val Ile Gly Tyr Leu Glu Asp 770 775 780	2352
CAG ATT ATG TCT TTG CAT GCT GAA ATC ATG GGG CTA CAG AAG AGC CCC Gln Ile Met Ser Leu His Ala Glu Ile Met Gly Leu Gln Lys Ser Pro 785 790 795 800	2400
TAT GGA AGA CGT CAG GGA GAC TTG ATG GAA TCT CTG GAA CAG CGT GCC Tyr Gly Arg Arg Gln Gly Asp Leu Met Glu Ser Leu Glu Gln Arg Ala 805 810 815	2448
ATT GAT CTA TAT AAG CAG TTA AAA CAC AGA CCT TCA GAT CAC TCC TAC Ile Asp Leu Tyr Lys Gln Leu Lys His Arg Pro Ser Asp His Ser Tyr 820 825 830	2496
AGT GAC AGC ACA GAG ATG GTG AAA ATC ATT GTG CAC ACT GTG CAG AGT Ser Asp Ser Thr Glu Met Val Lys Ile Ile Val His Thr Val Gln Ser 835 840 845	2544
CAG GAC CGT GTG CTC AAG GAG CTG TTT GGT CAT TTG AGC AAG TTG TTG Gln Asp Arg Val Leu Lys Glu Leu Phe Gly His Leu Ser Lys Leu Leu 850 855 860	2592
GGC TGT AAG CAG AAG ATT ATT GAT CTA CTC CCT AAG GTG GAA GTG GCC Gly Cys Lys Gln Lys Ile Ile Asp Leu Leu Pro Lys Val Glu Val Ala 865 870 875 880	2640
CTC AGT AAT ATC AAA GAA GCT GAC AAT ACT GTC ATG TTC ATG CAG GGA Leu Ser Asn Ile Lys Glu Ala Asp Asn Thr Val Met Phe Met Gln Gly 885 890 895	2688
AAA AGG CAG AAA GAA ATA TGG CAT CTC CTT AAA ATT GCC TGT ACA CAG Lys Arg Gln Lys Glu Ile Trp His Leu Leu Lys Ile Ala Cys Thr Gln 900 905 910	2736
AGT TCT GCC CGC TCT CTT GTA GGA TCC AGT CTA GAA GGT GCA GTA ACC Ser Ser Ala Arg Ser Leu Val Gly Ser Ser Leu Glu Gly Ala Val Thr 915 920 925	2784
CCT CAG ACA TCA GCA TGG CTG CCC CCG ACT TCA GCA GAA CAT GAT CAT Pro Gln Thr Ser Ala Trp Leu Pro Pro Thr Ser Ala Glu His Asp His 930 935 940	2832
TCT CTG TCA TGT GTG GTA ACT CCT CAA GAT GGG GAG ACT TCA GCA CAA Ser Leu Ser Cys Val Val Thr Pro Gln Asp Gly Glu Thr Ser Ala Gln 945 950 955 960	2880
ATG ATA GAA GAA AAT TTG AAC TGC CTT GGC CAT TTA AGC ACT ATT ATT Met Ile Glu Glu Asn Leu Asn Cys Leu Gly His Leu Ser Thr Ile Ile 965 970 975	2928
CAT GAG GCA AAT GAG GAA CAG GGC AAT AGT ATG ATG AAT CTT GAT TGG His Glu Ala Asn Glu Glu Gln Gly Asn Ser Met Met Asn Leu Asp Trp 980 985 990	2976
AGT TGG TTA ACA GAA TGA	2994



Ser Trp Leu Thr Glu  
995

(2) INFORMATION FOR SEQ ID NO:121:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 997 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:121:

Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	1	5	10	15
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	20	25	30	
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	35	40	45	
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	50	55	60	
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	65	70	75	80
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	85	90	95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	100	105	110	
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	115	120	125	
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	130	135	140	
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	145	150	155	160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	165	170	175	
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	180	185	190	
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	195	200	205	
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	210	215	220	
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	225	230	235	240
Gly	Leu	Arg	Ser	Arg	Ala	Gln	Ala	Ser	Asn	Ser	Thr	Met	Glu	Arg	Pro	245	250	255	
Pro	Gly	Leu	Arg	Pro	Gly	Ala	Gly	Gly	Pro	Trp	Glu	Met	Arg	Glu	Arg	260	265	270	
Leu	Gly	Thr	Gly	Gly	Phe	Gly	Asn	Val	Cys	Leu	Tyr	Gln	His	Arg	Glu	275	280	285	
Leu	Asp	Leu	Lys	Ile	Ala	Ile	Lys	Ser	Cys	Arg	Leu	Glu	Leu	Ser	Thr	290	295	300	
Lys	Asn	Arg	Glu	Arg	Trp	Cys	His	Glu	Ile	Gln	Ile	Met	Lys	Lys	Leu	305	310	315	320
Asn	His	Ala	Asn	Val	Val	Lys	Ala	Cys	Asp	Val	Pro	Glu	Glu	Leu	Asn				

				325					330				335		
Ile	Leu	Ile	His	Asp	Val	Pro	Leu	Leu	Ala	Met	Glu	Tyr	Cys	Ser	Gly
				340					345				350		
Gly	Asp	Leu	Arg	Lys	Leu	Leu	Asn	Lys	Pro	Glu	Asn	Cys	Cys	Gly	Leu
		355					360					365			
Lys	Glu	Ser	Gln	Ile	Leu	Ser	Leu	Leu	Ser	Asp	Ile	Gly	Ser	Gly	Ile
	370					375					380				
Arg	Tyr	Leu	His	Glu	Asn	Lys	Ile	Ile	His	Arg	Asp	Leu	Lys	Pro	Glu
385					390					395					400
Asn	Ile	Val	Leu	Gln	Asp	Val	Gly	Gly	Lys	Ile	Ile	His	Lys	Ile	Ile
				405					410					415	
Asp	Leu	Gly	Tyr	Ala	Lys	Asp	Val	Asp	Gln	Gly	Ser	Leu	Cys	Thr	Ser
		420						425					430		
Phe	Val	Gly	Thr	Leu	Gln	Tyr	Leu	Ala	Pro	Glu	Leu	Phe	Glu	Asn	Lys
	435						440					445			
Pro	Tyr	Thr	Ala	Thr	Val	Asp	Tyr	Trp	Ser	Phe	Gly	Thr	Met	Val	Phe
	450					455					460				
Glu	Cys	Ile	Ala	Gly	Tyr	Arg	Pro	Phe	Leu	His	His	Leu	Gln	Pro	Phe
465					470					475					480
Thr	Trp	His	Glu	Lys	Ile	Lys	Lys	Lys	Asp	Pro	Lys	Cys	Ile	Phe	Ala
				485					490					495	
Cys	Glu	Glu	Met	Ser	Gly	Glu	Val	Arg	Phe	Ser	Ser	His	Leu	Pro	Gln
			500					505					510		
Pro	Asn	Ser	Leu	Cys	Ser	Leu	Ile	Val	Glu	Pro	Met	Glu	Asn	Trp	Leu
	515						520					525			
Gln	Leu	Met	Leu	Asn	Trp	Asp	Pro	Gln	Gln	Arg	Gly	Gly	Pro	Val	Asp
	530					535					540				
Leu	Thr	Leu	Lys	Gln	Pro	Arg	Cys	Phe	Val	Leu	Met	Asp	His	Ile	Leu
545					550					555					560
Asn	Leu	Lys	Ile	Val	His	Ile	Leu	Asn	Met	Thr	Ser	Ala	Lys	Ile	Ile
				565					570					575	
Ser	Phe	Leu	Leu	Pro	Pro	Asp	Glu	Ser	Leu	His	Ser	Leu	Gln	Ser	Arg
		580						585					590		
Ile	Glu	Arg	Glu	Thr	Gly	Ile	Asn	Thr	Gly	Ser	Gln	Glu	Leu	Leu	Ser
	595						600					605			
Glu	Thr	Gly	Ile	Ser	Leu	Asp	Pro	Arg	Lys	Pro	Ala	Ser	Gln	Cys	Val
	610					615					620				
Leu	Asp	Gly	Val	Arg	Gly	Cys	Asp	Ser	Tyr	Met	Val	Tyr	Leu	Phe	Asp
625					630					635					640
Lys	Ser	Lys	Thr	Val	Tyr	Glu	Gly	Pro	Phe	Ala	Ser	Arg	Ser	Leu	Ser
				645					650					655	
Asp	Cys	Val	Asn	Tyr	Ile	Val	Gln	Asp	Ser	Lys	Ile	Gln	Leu	Pro	Ile
				660				665					670		
Ile	Gln	Leu	Arg	Lys	Val	Trp	Ala	Glu	Ala	Val	His	Tyr	Val	Ser	Gly
	675						680					685			
Leu	Lys	Glu	Asp	Tyr	Ser	Arg	Leu	Phe	Gln	Gly	Gln	Arg	Ala	Ala	Met
	690					695					700				
Leu	Ser	Leu	Leu	Arg	Tyr	Asn	Ala	Asn	Leu	Thr	Lys	Met	Lys	Asn	Thr
705					710					715					720
Leu	Ile	Ser	Ala	Ser	Gln	Gln	Leu	Lys	Ala	Lys	Leu	Glu	Phe	Phe	His
				725						730				735	
Lys	Ser	Ile	Gln	Leu	Asp	Leu	Glu	Arg	Tyr	Ser	Glu	Gln	Met	Thr	Tyr
				740				745					750		
Gly	Ile	Ser	Ser	Glu	Lys	Met	Leu	Lys	Ala	Trp	Lys	Glu	Met	Glu	Glu
	755						760					765			
Lys	Ala	Ile	His	Tyr	Ala	Glu	Val	Gly	Val	Ile	Gly	Tyr	Leu	Glu	Asp
	770					775					780				
Gln	Ile	Met	Ser	Leu	His	Ala	Glu	Ile	Met	Gly	Leu	Gln	Lys	Ser	Pro

785		790		795		800									
Tyr	Gly	Arg	Arg	Gln	Gly	Asp	Leu	Met	Glu	Ser	Leu	Glu	Gln	Arg	Ala
				805					810						815
Ile	Asp	Leu	Tyr	Lys	Gln	Leu	Lys	His	Arg	Pro	Ser	Asp	His	Ser	Tyr
			820					825					830		
Ser	Asp	Ser	Thr	Glu	Met	Val	Lys	Ile	Ile	Val	His	Thr	Val	Gln	Ser
			835				840					845			
Gln	Asp	Arg	Val	Leu	Lys	Glu	Leu	Phe	Gly	His	Leu	Ser	Lys	Leu	Leu
			850			855					860				
Gly	Cys	Lys	Gln	Lys	Ile	Ile	Asp	Leu	Leu	Pro	Lys	Val	Glu	Val	Ala
			865			870				875					880
Leu	Ser	Asn	Ile	Lys	Glu	Ala	Asp	Asn	Thr	Val	Met	Phe	Met	Gln	Gly
			885					890						895	
Lys	Arg	Gln	Lys	Glu	Ile	Trp	His	Leu	Leu	Lys	Ile	Ala	Cys	Thr	Gln
			900					905					910		
Ser	Ser	Ala	Arg	Ser	Leu	Val	Gly	Ser	Ser	Leu	Glu	Gly	Ala	Val	Thr
			915				920					925			
Pro	Gln	Thr	Ser	Ala	Trp	Leu	Pro	Pro	Thr	Ser	Ala	Glu	His	Asp	His
			930			935					940				
Ser	Leu	Ser	Cys	Val	Val	Thr	Pro	Gln	Asp	Gly	Glu	Thr	Ser	Ala	Gln
			945			950				955					960
Met	Ile	Glu	Glu	Asn	Leu	Asn	Cys	Leu	Gly	His	Leu	Ser	Thr	Ile	Ile
			965					970						975	
His	Glu	Ala	Asn	Glu	Glu	Gln	Gly	Asn	Ser	Met	Met	Asn	Leu	Asp	Trp
			980					985					990		
Ser	Trp	Leu	Thr	Glu											
			995												

## (2) INFORMATION FOR SEQ ID NO:122:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2991 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2988
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:122:

ATG	GAG	CGG	CCC	CCG	GGG	CTG	CGG	CCG	GGC	GCG	GGC	GGG	CCC	TGG	GAG	48
Met	Glu	Arg	Pro	Pro	Gly	Leu	Arg	Pro	Gly	Ala	Gly	Gly	Pro	Trp	Glu	
1				5				10					15			
ATG	CGG	GAG	CGG	CTG	GGC	ACC	GGC	GGC	TTC	GGG	AAC	GTC	TGT	CTG	TAC	96
Met	Arg	Glu	Arg	Leu	Gly	Thr	Gly	Gly	Phe	Gly	Asn	Val	Cys	Leu	Tyr	
			20				25					30				
CAG	CAT	CGG	GAA	CTT	GAT	CTC	AAA	ATA	GCA	ATT	AAG	TCT	TGT	CGC	CTA	144
Gln	His	Arg	Glu	Leu	Asp	Leu	Lys	Ile	Ala	Ile	Lys	Ser	Cys	Arg	Leu	
			35			40					45					
GAG	CTA	AGT	ACC	AAA	AAC	AGA	GAA	CGA	TGG	TGC	CAT	GAA	ATC	CAG	ATT	192

Glu	Leu	Ser	Thr	Lys	Asn	Arg	Glu	Arg	Trp	Cys	His	Glu	Ile	Gln	Ile	
50						55					60					
ATG	AAG	AAG	TTG	AAC	CAT	GCC	AAT	GTT	GTA	AAG	GCC	TGT	GAT	GTT	CCT	240
Met	Lys	Lys	Leu	Asn	His	Ala	Asn	Val	Val	Lys	Ala	Cys	Asp	Val	Pro	
65				70						75				80		
GAA	GAA	TTG	AAT	ATT	TTG	ATT	CAT	GAT	GTG	CCT	CTT	CTA	GCA	ATG	GAA	288
Glu	Glu	Leu	Asn	Ile	Leu	Ile	His	Asp	Val	Pro	Leu	Leu	Ala	Met	Glu	
			85					90					95			
TAC	TGT	TCT	GGA	GGA	GAT	CTC	CGA	AAG	CTG	CTC	AAC	AAA	CCA	GAA	AAT	336
Tyr	Cys	Ser	Gly	Gly	Asp	Leu	Arg	Lys	Leu	Leu	Asn	Lys	Pro	Glu	Asn	
			100					105					110			
TGT	TGT	GGA	CTT	AAA	GAA	AGC	CAG	ATA	CTT	TCT	TTA	CTA	AGT	GAT	ATA	384
Cys	Cys	Gly	Leu	Lys	Glu	Ser	Gln	Ile	Leu	Ser	Leu	Ser	Asp	Ile		
		115					120					125				
GGG	TCT	GGG	ATT	CGA	TAT	TTG	CAT	GAA	AAC	AAA	ATT	ATA	CAT	CGA	GAT	432
Gly	Ser	Gly	Ile	Arg	Tyr	Leu	His	Glu	Asn	Lys	Ile	Ile	His	Arg	Asp	
	130					135					140					
CTA	AAA	CCT	GAA	AAC	ATA	GTT	CTT	CAG	GAT	GTT	GGT	GGA	AAG	ATA	ATA	480
Leu	Lys	Pro	Glu	Asn	Ile	Val	Leu	Gln	Asp	Val	Gly	Gly	Lys	Ile	Ile	
145				150					155					160		
CAT	AAA	ATA	ATT	GAT	CTG	GGA	TAT	GCC	AAA	GAT	GTT	GAT	CAA	GGA	AGT	528
His	Lys	Ile	Ile	Asp	Leu	Gly	Tyr	Ala	Lys	Asp	Val	Asp	Gln	Gly	Ser	
			165					170					175			
CTG	TGT	ACA	TCT	TTT	GTG	GGA	ACA	CTG	CAG	TAT	CTG	GCC	CCA	GAG	CTC	576
Leu	Cys	Thr	Ser	Phe	Val	Gly	Thr	Leu	Gln	Tyr	Leu	Ala	Pro	Glu	Leu	
			180					185					190			
TTT	GAG	AAT	AAG	CCT	TAC	ACA	GCC	ACT	GTT	GAT	TAT	TGG	AGC	TTT	GGG	624
Phe	Glu	Asn	Lys	Pro	Tyr	Thr	Ala	Thr	Val	Asp	Tyr	Trp	Ser	Phe	Gly	
	195						200					205				
ACC	ATG	GTA	TTT	GAA	TGT	ATT	GCT	GGA	TAT	AGG	CCT	TTT	TTG	CAT	CAT	672
Thr	Met	Val	Phe	Glu	Cys	Ile	Ala	Gly	Tyr	Arg	Pro	Phe	Leu	His	His	
	210					215					220					
CTG	CAG	CCA	TTT	ACC	TGG	CAT	GAG	AAG	ATT	AAG	AAG	AAG	GAT	CCA	AAG	720
Leu	Gln	Pro	Phe	Thr	Trp	His	Glu	Lys	Ile	Lys	Lys	Lys	Asp	Pro	Lys	
225				230					235					240		
TGT	ATA	TTT	GCA	TGT	GAA	GAG	ATG	TCA	GGA	GAA	GTT	CGG	TTT	AGT	AGC	768
Cys	Ile	Phe	Ala	Cys	Glu	Glu	Met	Ser	Gly	Glu	Val	Arg	Phe	Ser	Ser	
			245					250					255			
CAT	TTA	CCT	CAA	CCA	AAT	AGC	CTT	TGT	AGT	TTA	ATA	GTA	GAA	CCC	ATG	816
His	Leu	Pro	Gln	Pro	Asn	Ser	Leu	Cys	Ser	Leu	Ile	Val	Glu	Pro	Met	
		260					265						270			
GAA	AAC	TGG	CTA	CAG	TTG	ATG	TTG	AAT	TGG	GAC	CCT	CAG	CAG	AGA	GGA	864
Glu	Asn	Trp	Leu	Gln	Leu	Met	Leu	Asn	Trp	Asp	Pro	Gln	Gln	Arg	Gly	
	275					280						285				

GGA CCT GTT GAC CTT ACT TTG AAG CAG CCA AGA TGT TTT GTA TTA ATG Gly Pro Val Asp Leu Thr Leu Lys Gln Pro Arg Cys Phe Val Leu Met 290 295 300	912
GAT CAC ATT TTG AAT TTG AAG ATA GTA CAC ATC CTA AAT ATG ACT TCT Asp His Ile Leu Asn Leu Lys Ile Val His Ile Leu Asn Met Thr Ser 305 310 315 320	960
GCA AAG ATA ATT TCT TTT CTG TTA CCA CCT GAT GAA AGT CTT CAT TCA Ala Lys Ile Ile Ser Phe Leu Leu Pro Pro Asp Glu Ser Leu His Ser 325 330 335	1008
CTA CAG TCT CGT ATT GAG CGT GAA ACT GGA ATA AAT ACT GGT TCT CAA Leu Gln Ser Arg Ile Glu Arg Glu Thr Gly Ile Asn Thr Gly Ser Gln 340 345 350	1056
GAA CTT CTT TCA GAG ACA GGA ATT TCT CTG GAT CCT CGG AAA CCA GCC Glu Leu Leu Ser Glu Thr Gly Ile Ser Leu Asp Pro Arg Lys Pro Ala 355 360 365	1104
TCT CAA TGT GTT CTA GAT GGA GTT AGA GGC TGT GAT AGC TAT ATG GTT Ser Gln Cys Val Leu Asp Gly Val Arg Gly Cys Asp Ser Tyr Met Val 370 375 380	1152
TAT TTG TTT GAT AAA AGT AAA ACT GTA TAT GAA GGG CCA TTT GCT TCC Tyr Leu Phe Asp Lys Ser Lys Thr Val Tyr Glu Gly Pro Phe Ala Ser 385 390 395 400	1200
AGA AGT TTA TCT GAT TGT GTA AAT TAT ATT GTA CAG GAC AGC AAA ATA Arg Ser Leu Ser Asp Cys Val Asn Tyr Ile Val Gln Asp Ser Lys Ile 405 410 415	1248
CAG CTT CCA ATT ATA CAG CTG CGT AAA GTG TGG GCT GAA GCA GTG CAC Gln Leu Pro Ile Ile Gln Leu Arg Lys Val Trp Ala Glu Ala Val His 420 425 430	1296
TAT GTG TCT GGA CTA AAA GAA GAC TAT AGC AGG CTC TTT CAG GGA CAA Tyr Val Ser Gly Leu Lys Glu Asp Tyr Ser Arg Leu Phe Gln Gly Gln 435 440 445	1344
AGG GCA GCA ATG TTA AGT CTT CTT AGA TAT AAT GCT AAC TTA ACA AAA Arg Ala Ala Met Leu Ser Leu Leu Arg Tyr Asn Ala Asn Leu Thr Lys 450 455 460	1392
ATG AAG AAC ACT TTG ATC TCA GCA TCA CAA CAA CTG AAA GCT AAA TTG Met Lys Asn Thr Leu Ile Ser Ala Ser Gln Gln Leu Lys Ala Lys Leu 465 470 475 480	1440
GAG TTT TTT CAC AAA AGC ATT CAG CTT GAC TTG GAG AGA TAC AGC GAG Glu Phe Phe His Lys Ser Ile Gln Leu Asp Leu Glu Arg Tyr Ser Glu 485 490 495	1488
CAG ATG ACG TAT GGG ATA TCT TCA GAA AAA ATG CTA AAA GCA TGG AAA Gln Met Thr Tyr Gly Ile Ser Ser Glu Lys Met Leu Lys Ala Trp Lys 500 505 510	1536
GAA ATG GAA GAA AAG GCC ATC CAC TAT GCT GAG GTT GGT GTC ATT GGA	1584



CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG	2304
Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly	
755 760 765	
GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG	2352
Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His Lys	
770 775 780	
TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG	2400
Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu	
785 790 795 800	
ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC	2448
Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro	
805 810 815	
ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC	2496
Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr	
820 825 830	
CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA	2544
Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu	
835 840 845	
GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC	2592
Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr	
850 855 860	
AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC	2640
Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg	
865 870 875 880	
ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG	2688
Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly	
885 890 895	
CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC	2736
His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala	
900 905 910	
GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC	2784
Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn	
915 920 925	
ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC	2832
Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr	
930 935 940	
CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC	2880
Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser	
945 950 955 960	
ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG	2928
Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met	
965 970 975	
GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC	2976

Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp  
 980 985 990

GAG CTG TAC AAG TAA  
 Glu Leu Tyr Lys  
 995

2991

## (2) INFORMATION FOR SEQ ID NO:123:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 996 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:123:

Met Glu Arg Pro Pro Gly Leu Arg Pro Gly Ala Gly Gly Pro Trp Glu  
 1 5 10 15  
 Met Arg Glu Arg Leu Gly Thr Gly Gly Phe Gly Asn Val Cys Leu Tyr  
 20 25 30  
 Gln His Arg Glu Leu Asp Leu Lys Ile Ala Ile Lys Ser Cys Arg Leu  
 35 40 45  
 Glu Leu Ser Thr Lys Asn Arg Glu Arg Trp Cys His Glu Ile Gln Ile  
 50 55 60  
 Met Lys Lys Leu Asn His Ala Asn Val Val Lys Ala Cys Asp Val Pro  
 65 70 75 80  
 Glu Glu Leu Asn Ile Leu Ile His Asp Val Pro Leu Leu Ala Met Glu  
 85 90 95  
 Tyr Cys Ser Gly Gly Asp Leu Arg Lys Leu Leu Asn Lys Pro Glu Asn  
 100 105 110  
 Cys Cys Gly Leu Lys Glu Ser Gln Ile Leu Ser Leu Leu Ser Asp Ile  
 115 120 125  
 Gly Ser Gly Ile Arg Tyr Leu His Glu Asn Lys Ile Ile His Arg Asp  
 130 135 140  
 Leu Lys Pro Glu Asn Ile Val Leu Gln Asp Val Gly Gly Lys Ile Ile  
 145 150 155 160  
 His Lys Ile Ile Asp Leu Gly Tyr Ala Lys Asp Val Asp Gln Gly Ser  
 165 170 175  
 Leu Cys Thr Ser Phe Val Gly Thr Leu Gln Tyr Leu Ala Pro Glu Leu  
 180 185 190  
 Phe Glu Asn Lys Pro Tyr Thr Ala Thr Val Asp Tyr Trp Ser Phe Gly  
 195 200 205  
 Thr Met Val Phe Glu Cys Ile Ala Gly Tyr Arg Pro Phe Leu His His  
 210 215 220  
 Leu Gln Pro Phe Thr Trp His Glu Lys Ile Lys Lys Lys Asp Pro Lys  
 225 230 235 240  
 Cys Ile Phe Ala Cys Glu Glu Met Ser Gly Glu Val Arg Phe Ser Ser  
 245 250 255  
 His Leu Pro Gln Pro Asn Ser Leu Cys Ser Leu Ile Val Glu Pro Met  
 260 265 270  
 Glu Asn Trp Leu Gln Leu Met Leu Asn Trp Asp Pro Gln Gln Arg Gly  
 275 280 285  
 Gly Pro Val Asp Leu Thr Leu Lys Gln Pro Arg Cys Phe Val Leu Met



290	295	300
Asp His Ile Leu Asn Leu Lys Ile Val His Ile Leu Asn Met Thr Ser		
305	310	315
Ala Lys Ile Ile Ser Phe Leu Leu Pro Pro Asp Glu Ser Leu His Ser		320
	325	330
Leu Gln Ser Arg Ile Glu Arg Glu Thr Gly Ile Asn Thr Gly Ser Gln		335
	340	345
Glu Leu Leu Ser Glu Thr Gly Ile Ser Leu Asp Pro Arg Lys Pro Ala		350
	355	360
Ser Gln Cys Val Leu Asp Gly Val Arg Gly Cys Asp Ser Tyr Met Val		365
	370	375
Tyr Leu Phe Asp Lys Ser Lys Thr Val Tyr Glu Gly Pro Phe Ala Ser		380
	385	390
Arg Ser Leu Ser Asp Cys Val Asn Tyr Ile Val Gln Asp Ser Lys Ile		395
	405	410
Gln Leu Pro Ile Ile Gln Leu Arg Lys Val Trp Ala Glu Ala Val His		415
	420	425
Tyr Val Ser Gly Leu Lys Glu Asp Tyr Ser Arg Leu Phe Gln Gly Gln		430
	435	440
Arg Ala Ala Met Leu Ser Leu Arg Tyr Asn Ala Asn Leu Thr Lys		445
	450	455
Met Lys Asn Thr Leu Ile Ser Ala Ser Gln Gln Leu Lys Ala Lys Leu		460
	465	470
Glu Phe Phe His Lys Ser Ile Gln Leu Asp Leu Glu Arg Tyr Ser Glu		475
	485	490
Gln Met Thr Tyr Gly Ile Ser Ser Glu Lys Met Leu Lys Ala Trp Lys		495
	500	505
Glu Met Glu Glu Lys Ala Ile His Tyr Ala Glu Val Gly Val Ile Gly		510
	515	520
Tyr Leu Glu Asp Gln Ile Met Ser Leu His Ala Glu Ile Met Gly Leu		525
	530	535
Gln Lys Ser Pro Tyr Gly Arg Arg Gln Gly Asp Leu Met Glu Ser Leu		540
	545	550
Glu Gln Arg Ala Ile Asp Leu Tyr Lys Gln Leu Lys His Arg Pro Ser		555
	565	570
Asp His Ser Tyr Ser Asp Ser Thr Glu Met Val Lys Ile Ile Val His		575
	580	585
Thr Val Gln Ser Gln Asp Arg Val Leu Lys Glu Leu Phe Gly His Leu		590
	595	600
Ser Lys Leu Leu Gly Cys Lys Gln Lys Ile Ile Asp Leu Leu Pro Lys		605
	610	615
Val Glu Val Ala Leu Ser Asn Ile Lys Glu Ala Asp Asn Thr Val Met		620
	625	630
Phe Met Gln Gly Lys Arg Gln Lys Glu Ile Trp His Leu Leu Lys Ile		635
	645	650
Ala Cys Thr Gln Ser Ser Ala Arg Ser Leu Val Gly Ser Ser Leu Glu		655
	660	665
Gly Ala Val Thr Pro Gln Thr Ser Ala Trp Leu Pro Pro Thr Ser Ala		670
	675	680
Glu His Asp His Ser Leu Ser Cys Val Val Thr Pro Gln Asp Gly Glu		685
	690	695
Thr Ser Ala Gln Met Ile Glu Glu Asn Leu Asn Cys Leu Gly His Leu		700
	705	710
Ser Thr Ile Ile His Glu Ala Asn Glu Glu Gln Gly Asn Ser Met Met		715
	725	730
Asn Leu Asp Trp Ser Trp Leu Thr Glu Trp Val Pro Arg Ala Arg Asp		735
	740	745
Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly		750

755	760	765
Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His Lys		
770	775	780
Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu		
785	790	795
Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro		800
	805	810
Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr		815
	820	825
Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu		830
	835	840
Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr		845
	850	855
Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg		860
865	870	875
Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly		880
	885	890
His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala		895
	900	905
Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn		910
	915	920
Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr		925
	930	935
Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser		940
945	950	955
Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met		960
	965	970
Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp		975
	980	985
Glu Leu Tyr Lys		990
995		

## (2) INFORMATION FOR SEQ ID NO:124:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1908 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1905
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:124:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144

Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	
	35						40					45				
TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	192
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	
	50					55					60					
CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	240
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	
65					70					75					80	
CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	288
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	
				85					90					95		
CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	AAG	ACC	CGC	GCC	GAG	336
Arg	Thr	Ile	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu		
			100				105						110			
GTG	AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	CGC	ATC	GAG	CTG	AAG	GGC	384
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	
	115						120					125				
ATC	GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	CTG	GGG	CAC	AAG	CTG	GAG	TAC	432
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	
	130					135					140					
AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	GCC	GAC	AAG	CAG	AAG	AAC	480
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	
145					150					155					160	
GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	AAC	ATC	GAG	GAC	GGC	AGC	528
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	
				165					170					175		
GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	ACC	CCC	ATC	GGC	GAC	GGC	576
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	
			180					185					190			
CCC	GTG	CTG	CTG	CCC	GAC	AAC	CAC	TAC	CTG	AGC	ACC	CAG	TCC	GCC	CTG	624
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	
		195					200					205				
AGC	AAA	GAC	CCC	AAC	GAG	AAG	CGC	GAT	CAC	ATG	GTC	CTG	CTG	GAG	TTC	672
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	
	210					215					220					
GTG	ACC	GCC	GCC	GGG	ATC	ACT	CTC	GGC	ATG	GAC	GAG	CTG	TAC	AAG	TCC	720
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	
225					230					235					240	
GGA	CTC	AGA	TCT	CGA	GCT	CAA	GCT	TCC	ATG	AGC	GAG	ACG	GTC	ATC	ATG	768
Gly	Leu	Arg	Ser	Arg	Ala	Gln	Ala	Ser	Met	Ser	Glu	Thr	Val	Ile	Met	
				245					250					255		
AGC	GAG	ACG	GTC	ATC	TGT	TCC	AGC	CGG	GCC	ACT	GTG	ATG	CTT	TAT	GAT	816
Ser	Glu	Thr	Val	Ile	Cys	Ser	Ser	Arg	Ala	Thr	Val	Met	Leu	Tyr	Asp	
			260					265						270		

GAT GGC AAC AAG CGA TGG CTC CCT GCT GGC ACG GGT CCC CAG GCC TTC	864
Asp Gly Asn Lys Arg Trp Leu Pro Ala Gly Thr Gly Pro Gln Ala Phe	
275 280 285	
AGC CGC GTC CAG ATC TAC CAC AAC CCC ACG GCC AAT TCC TTT CGC GTC	912
Ser Arg Val Gln Ile Tyr His Asn Pro Thr Ala Asn Ser Phe Arg Val	
290 295 300	
GTG GGC CGG AAG ATG CAG CCC GAC CAG CAG GTG GTC ATC AAC TGT GCC	960
Val Gly Arg Lys Met Gln Pro Asp Gln Gln Val Val Ile Asn Cys Ala	
305 310 315 320	
ATC GTC CGG GGT GTC AAG TAT AAC CAG GCC ACC CCC AAC TTC CAT CAG	1008
Ile Val Arg Gly Val Lys Tyr Asn Gln Ala Thr Pro Asn Phe His Gln	
325 330 335	
TGG CGC GAC GCT CGC CAG GTC TGG GGC CTC AAC TTC GGC AGC AAG GAG	1056
Trp Arg Asp Ala Arg Gln Val Trp Gly Leu Asn Phe Gly Ser Lys Glu	
340 345 350	
GAT GCG GCC CAG TTT GCC GCC GGC ATG GCC AGT GCC CTA GAG GCG TTG	1104
Asp Ala Ala Gln Phe Ala Ala Gly Met Ala Ser Ala Leu Glu Ala Leu	
355 360 365	
GAA GGA GGT GGG CCC CCT CCA CCC CCA GCA CTT CCC ACC TGG TCG GTC	1152
Glu Gly Gly Gly Pro Pro Pro Pro Pro Ala Leu Pro Thr Trp Ser Val	
370 375 380	
CCG AAC GGC CCC TCC CCG GAG GAG GTG GAG CAG CAG AAA AGG CAG CAG	1200
Pro Asn Gly Pro Ser Pro Glu Glu Val Glu Gln Gln Lys Arg Gln Gln	
385 390 395 400	
CCC GGC CCG TCG GAG CAC ATA GAG CGC CGG GTC TCC AAT GCA GGA GGC	1248
Pro Gly Pro Ser Glu His Ile Glu Arg Arg Val Ser Asn Ala Gly Gly	
405 410 415	
CCA CCT GCT CCC CCC GCT GGG GGT CCA CCC CCA CCA CCA GGA CCT CCC	1296
Pro Pro Ala Pro Pro Ala Gly Gly Pro Pro Pro Pro Pro Gly Pro Pro	
420 425 430	
CCT CCT CCA GGT CCC CCC CCA CCC CCA GGT TTG CCC CCT TCG GGG GTC	1344
Pro Pro Pro Gly Pro Pro Pro Pro Gly Leu Pro Pro Ser Gly Val	
435 440 445	
CCA GCT GCA GCG CAC GGA GCA GGG GGA GGA CCA CCC CCT GCA CCC CCT	1392
Pro Ala Ala Ala His Gly Ala Gly Gly Gly Pro Pro Pro Ala Pro Pro	
450 455 460	
CTC CCG GCA GCA CAG GGC CCT GGT GGT GGG GGA GCT GGG GCC CCA GGC	1440
Leu Pro Ala Ala Gln Gly Pro Gly Gly Gly Gly Ala Gly Ala Pro Gly	
465 470 475 480	
CTG GCC GCA GCT ATT GCT GGA GCC AAA CTC AGG AAA GTC AGC AAG CAG	1488
Leu Ala Ala Ala Ile Ala Gly Ala Lys Leu Arg Lys Val Ser Lys Gln	
485 490 495	
GAG GAG GCC TCA GGG GGG CCC ACA GCC CCC AAA GCT GAG AGT GGT CGA	1536

Glu Glu Ala Ser Gly Gly Pro Thr Ala Pro Lys Ala Glu Ser Gly Arg  
 500 505 510  
 AGC GGA GGT GGG GGA CTC ATG GAA GAG ATG AAC GCC ATG CTG GCC CGG 1584  
 Ser Gly Gly Gly Gly Leu Met Glu Glu Met Asn Ala Met Leu Ala Arg  
 515 520 525  
 AGA AGG AAA GCC ACG CAA GTT GGG GAG AAA ACC CCC AAG GAT GAA TCT 1632  
 Arg Arg Lys Ala Thr Gln Val Gly Glu Lys Thr Pro Lys Asp Glu Ser  
 530 535 540  
 GCC AAT CAG GAG GAG CCA GAG GCC AGA GTC CCG GCC CAG AGT GAA TCT 1680  
 Ala Asn Gln Glu Glu Pro Glu Ala Arg Val Pro Ala Gln Ser Glu Ser  
 545 550 555 560  
 GTG CGG AGA CCC TGG GAG AAG AAC AGC ACA ACC TTG CCA AGG ATG AAG 1728  
 Val Arg Arg Pro Trp Glu Lys Asn Ser Thr Thr Leu Pro Arg Met Lys  
 565 570 575  
 TCG TCT TCT TCG GTG ACC ACT TCC GAG ACC CAA CCC TGC ACG CCC AGC 1776  
 Ser Ser Ser Ser Val Thr Thr Ser Glu Thr Gln Pro Cys Thr Pro Ser  
 580 585 590  
 TCC AGT GAT TAC TCG GAC CTA CAG AGG GTG AAA CAG GAG CTT CTG GAA 1824  
 Ser Ser Asp Tyr Ser Asp Leu Gln Arg Val Lys Gln Glu Leu Leu Glu  
 595 600 605  
 GAG GTG AAG AAG GAA TTG CAG AAA GTG AAA GAG GAA ATC ATT GAA GCC 1872  
 Glu Val Lys Lys Glu Leu Gln Lys Val Lys Glu Glu Ile Ile Glu Ala  
 610 615 620  
 TTC GTC CAG GAG CTG AGG AAG CGG GGT TCT CCC TGA 1908  
 Phe Val Gln Glu Leu Arg Lys Arg Gly Ser Pro  
 625 630 635

## (2) INFORMATION FOR SEQ ID NO:125:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 635 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:125:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu  
 1 5 10 15  
 Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly  
 20 25 30  
 Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile  
 35 40 45  
 Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr  
 50 55 60  
 Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys

65					70					75				80	
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu
			85						90					95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu
		100						105					110		
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly
		115					120					125			
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr
	130					135					140				
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn
145					150					155					160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser
			165					170					175		
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly
		180						185					190		
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu
	195					200						205			
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe
	210					215					220				
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser
225					230				235						240
Gly	Leu	Arg	Ser	Arg	Ala	Gln	Ala	Ser	Met	Ser	Glu	Thr	Val	Ile	Met
			245					250					255		
Ser	Glu	Thr	Val	Ile	Cys	Ser	Ser	Arg	Ala	Thr	Val	Met	Leu	Tyr	Asp
	260						265					270			
Asp	Gly	Asn	Lys	Arg	Trp	Leu	Pro	Ala	Gly	Thr	Gly	Pro	Gln	Ala	Phe
	275					280					285				
Ser	Arg	Val	Gln	Ile	Tyr	His	Asn	Pro	Thr	Ala	Asn	Ser	Phe	Arg	Val
	290				295						300				
Val	Gly	Arg	Lys	Met	Gln	Pro	Asp	Gln	Gln	Val	Val	Ile	Asn	Cys	Ala
305					310				315						320
Ile	Val	Arg	Gly	Val	Lys	Tyr	Asn	Gln	Ala	Thr	Pro	Asn	Phe	His	Gln
			325					330					335		
Trp	Arg	Asp	Ala	Arg	Gln	Val	Trp	Gly	Leu	Asn	Phe	Gly	Ser	Lys	Glu
	340						345					350			
Asp	Ala	Ala	Gln	Phe	Ala	Ala	Gly	Met	Ala	Ser	Ala	Leu	Glu	Ala	Leu
	355					360					365				
Glu	Gly	Gly	Gly	Pro	Pro	Pro	Pro	Pro	Ala	Leu	Pro	Thr	Trp	Ser	Val
	370					375					380				
Pro	Asn	Gly	Pro	Ser	Pro	Glu	Glu	Val	Glu	Gln	Gln	Lys	Arg	Gln	Gln
385					390				395						400
Pro	Gly	Pro	Ser	Glu	His	Ile	Glu	Arg	Arg	Val	Ser	Asn	Ala	Gly	Gly
			405					410					415		
Pro	Pro	Ala	Pro	Pro	Ala	Gly	Gly	Pro	Pro	Pro	Pro	Pro	Gly	Pro	Pro
	420						425					430			
Pro	Pro	Pro	Gly	Pro	Pro	Pro	Pro	Pro	Gly	Leu	Pro	Pro	Ser	Gly	Val
	435					440					445				
Pro	Ala	Ala	Ala	His	Gly	Ala	Gly	Gly	Gly	Pro	Pro	Pro	Ala	Pro	Pro
	450					455					460				
Leu	Pro	Ala	Ala	Gln	Gly	Pro	Gly	Gly	Gly	Gly	Ala	Gly	Ala	Pro	Gly
465				470				475							480
Leu	Ala	Ala	Ala	Ile	Ala	Gly	Ala	Lys	Leu	Arg	Lys	Val	Ser	Lys	Gln
			485					490					495		
Glu	Glu	Ala	Ser	Gly	Gly	Pro	Thr	Ala	Pro	Lys	Ala	Glu	Ser	Gly	Arg
		500						505				510			
Ser	Gly	Gly	Gly	Gly	Leu	Met	Glu	Glu	Met	Asn	Ala	Met	Leu	Ala	Arg
	515					520					525				
Arg	Arg	Lys	Ala	Thr	Gln	Val	Gly	Glu	Lys	Thr	Pro	Lys	Asp	Glu	Ser

- (i) SEQUENCE CHARACTERISTICS:
  - (A) LENGTH: 1329 base pairs
  - (B) TYPE: nucleic acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...1326  
(D) OTHER INFORMATION:

(x1) SEQUENCE															48	
ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	
Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	
1				5					10					15		
															96	
GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	
			20					25					30			
															144	
GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	
		35					40					45				
															192	
TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	
	50					55					60					
															240	
CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	
65					70					75				80		
															288	
CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	
				85					90					95		
															336	
CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	AAG	ACC	CGC	GCC	GAG	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	
				100				105					110			

GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125	384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GCT CAA GCT TCA ATG GCT GCC ATC CGG AAG AAA Gly Leu Arg Ser Arg Ala Gln Ala Ser Met Ala Ala Ile Arg Lys Lys 245 250 255	768
CTG GTG ATT GTT GGT GAT GGA GCC TGT GGA AAG ACA TGC TTG CTC ATA Leu Val Ile Val Gly Asp Gly Ala Cys Gly Lys Thr Cys Leu Leu Ile 260 265 270	816
GTC TTC AGC AAG GAC CAG TTC CCA GAG GTG TAT GTG CCC ACA GTG TTT Val Phe Ser Lys Asp Gln Phe Pro Glu Val Tyr Val Pro Thr Val Phe 275 280 285	864
GAG AAC TAT GTG GCA GAT ATC GAG GTG GAT GGA AAG CAG GTA GAG TTG Glu Asn Tyr Val Ala Asp Ile Glu Val Asp Gly Lys Gln Val Glu Leu 290 295 300	912
GCT TTG TGG GAC ACA GCT GGG CAG GAA GAT TAT GAT CGC CTG AGG CCC Ala Leu Trp Asp Thr Ala Gly Gln Glu Asp Tyr Asp Arg Leu Arg Pro 305 310 315 320	960
CTC TCC TAC CCA GAT ACC GAT GTT ATA CTG ATG TGT TTT TCC ATC GAC Leu Ser Tyr Pro Asp Thr Asp Val Ile Leu Met Cys Phe Ser Ile Asp 325 330 335	1008
AGC CCT GAT AGT TTA GAA AAC ATC CCA GAA AAG TGG ACC CCA GAA GTC	1056



Ser	Pro	Asp	Ser	Leu	Glu	Asn	Ile	Pro	Glu	Lys	Trp	Thr	Pro	Glu	Val		
			340					345					350				
AAG	CAT	TTC	TGT	CCC	AAC	GTG	CCC	ATC	ATC	CTG	GTT	GGG	AAT	AAG	AAG	1104	
Lys	His	Phe	Cys	Pro	Asn	Val	Pro	Ile	Ile	Leu	Val	Gly	Asn	Lys	Lys		
			355				360					365					
GAT	CTT	CGG	AAT	GAT	GAG	CAC	ACA	AGG	CGG	GAG	CTA	GCC	AAG	ATG	AAG	1152	
Asp	Leu	Arg	Asn	Asp	Glu	His	Thr	Arg	Arg	Glu	Leu	Ala	Lys	Met	Lys		
			370				375					380					
CAG	GAG	CCG	GTG	AAA	CCT	GAA	GAA	GGC	AGA	GAT	ATG	GCA	AAC	AGG	ATT	1200	
Gln	Glu	Pro	Val	Lys	Pro	Glu	Glu	Gly	Arg	Asp	Met	Ala	Asn	Arg	Ile		
			385			390				395					400		
GGC	GCT	TTT	GGG	TAC	ATG	GAG	TGT	TCA	GCA	AAG	ACC	AAA	GAT	GGA	GTG	1248	
Gly	Ala	Phe	Gly	Tyr	Met	Glu	Cys	Ser	Ala	Lys	Thr	Lys	Asp	Gly	Val		
				405					410					415			
AGA	GAG	GTT	TTT	GAA	ATG	GCT	ACG	AGA	GCT	GCT	CTG	CAA	GCT	AGA	CGT	1296	
Arg	Glu	Val	Phe	Glu	Met	Ala	Thr	Arg	Ala	Ala	Leu	Gln	Ala	Arg	Arg		
				420				425						430			
GGG	AAG	AAA	AAA	TCT	GGT	TGC	CTT	GTC	TTG	TGA						1329	
Gly	Lys	Lys	Lys	Ser	Gly	Cys	Leu	Val	Leu								
			435				440										

## (2) INFORMATION FOR SEQ ID NO:127:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 442 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:127:

Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu		
1				5					10					15			
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly		
			20					25					30				
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile		
			35				40						45				
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr		
			50				55				60						
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys		
65				70					75				80				
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu		
			85					90					95				
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu		
			100				105						110				
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly		
			115				120					125					
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr		

130		135		140
Asn Tyr Asn Ser His	Asn Val Tyr Ile Met	Ala Asp Lys Gln Lys Asn		
145	150	155	160	
Gly Ile Lys Val Asn Phe	Lys Ile Arg His Asn Ile	Glu Asp Gly Ser		
	165	170	175	
Val Gln Leu Ala Asp	His Tyr Gln Gln Asn Thr	Pro Ile Gly Asp Gly		
	180	185	190	
Pro Val Leu Leu Pro	Asp Asn His Tyr Leu Ser Thr	Gln Ser Ala Leu		
	195	200	205	
Ser Lys Asp Pro Asn	Glu Lys Arg Asp His Met Val	Leu Leu Glu Phe		
	210	215	220	
Val Thr Ala Ala Gly	Ile Thr Leu Gly Met Asp	Glu Leu Tyr Lys Ser		
225	230	235	240	
Gly Leu Arg Ser Arg	Ala Gln Ala Ser Met Ala	Ala Ile Arg Lys Lys		
	245	250	255	
Leu Val Ile Val Gly	Asp Gly Ala Cys Gly Lys Thr	Cys Leu Leu Ile		
	260	265	270	
Val Phe Ser Lys Asp	Gln Phe Pro Glu Val Tyr Val	Pro Thr Val Phe		
	275	280	285	
Glu Asn Tyr Val Ala	Asp Ile Glu Val Asp Gly Lys	Gln Val Glu Leu		
	290	295	300	
Ala Leu Trp Asp Thr	Ala Gly Gln Glu Asp Tyr Asp	Arg Leu Arg Pro		
305	310	315	320	
Leu Ser Tyr Pro Asp	Thr Asp Val Ile Leu Met Cys Phe	Ser Ile Asp		
	325	330	335	
Ser Pro Asp Ser Leu	Glu Asn Ile Pro Glu Lys Trp Thr	Pro Glu Val		
	340	345	350	
Lys His Phe Cys Pro	Asn Val Pro Ile Ile Leu Val	Gly Asn Lys Lys		
	355	360	365	
Asp Leu Arg Asn Asp	Glu His Thr Arg Arg Glu Leu	Ala Lys Met Lys		
	370	375	380	
Gln Glu Pro Val Lys	Pro Glu Glu Gly Arg Asp Met	Ala Asn Arg Ile		
385	390	395	400	
Gly Ala Phe Gly Tyr	Met Glu Cys Ser Ala Lys Thr	Lys Asp Gly Val		
	405	410	415	
Arg Glu Val Phe Glu	Met Ala Thr Arg Ala Ala Leu	Gln Ala Arg Arg		
	420	425	430	
Gly Lys Lys Lys Ser	Gly Cys Leu Val Leu			
	435	440		

## (2) INFORMATION FOR SEQ ID NO:128:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1140 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...1137
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:128:

ATG GAC CAT TAT GAT TCT CAG CAA ACC AAC GAT TAC ATG CAG CCA GAA. 48

Met	Asp	His	Tyr	Asp	Ser	Gln	Gln	Thr	Asn	Asp	Tyr	Met	Gln	Pro	Glu	
1				5					10					15		
GAG	GAC	TGG	GAC	CGG	GAC	CTG	CTC	CTG	GAC	CCG	GCC	TGG	GAG	AAG	CAG	96
Glu	Asp	Trp	Asp	Arg	Asp	Leu	Leu	Leu	Asp	Pro	Ala	Trp	Glu	Lys	Gln	
			20					25					30			
CAG	AGA	AAG	ACA	TTC	ACG	GCA	TGG	TGT	AAC	TCC	CAC	CTC	CGG	AAG	GCG	144
Gln	Arg	Lys	Thr	Phe	Thr	Ala	Trp	Cys	Asn	Ser	His	Leu	Arg	Lys	Ala	
		35					40					45				
GGG	ACA	CAG	ATC	GAG	AAC	ATC	GAA	GAG	GAC	TTC	CGG	GAT	GGC	CTG	AAG	192
Gly	Thr	Gln	Ile	Glu	Asn	Ile	Glu	Glu	Asp	Phe	Arg	Asp	Gly	Leu	Lys	
	50					55			60							
CTC	ATG	CTG	CTG	CTG	GAG	GTC	ATC	TCA	GGT	GAA	CGC	TTG	GCC	AAG	CCA	240
Leu	Met	Leu	Leu	Leu	Glu	Val	Ile	Ser	Gly	Glu	Arg	Leu	Ala	Lys	Pro	
65					70				75					80		
GAG	CGA	GGC	AAG	ATG	AGA	GTG	CAC	AAG	ATC	TCC	AAC	GTC	AAC	AAG	GCC	288
Glu	Arg	Gly	Lys	Met	Arg	Val	His	Lys	Ile	Ser	Asn	Val	Asn	Lys	Ala	
			85					90					95			
CTG	GAT	TTC	ATA	GCC	AGC	AAA	GGC	GTC	AAA	CTG	GTG	TCC	ATC	GGA	GCC	336
Leu	Asp	Phe	Ile	Ala	Ser	Lys	Gly	Val	Lys	Leu	Val	Ser	Ile	Gly	Ala	
		100					105					110				
GAA	GAA	ATC	GTG	GAT	GGG	AAT	GTG	AAG	ATG	ACC	CTG	GGC	ATG	ATC	TGG	384
Glu	Glu	Ile	Val	Asp	Gly	Asn	Val	Lys	Met	Thr	Leu	Gly	Met	Ile	Trp	
	115					120					125					
ACC	ATC	ATC	CTG	CGC	AGG	GAT	CCA	CCG	GTC	GCC	ACC	ATG	GTG	AGC	AAG	432
Thr	Ile	Ile	Leu	Arg	Arg	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	
	130				135				140							
GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	GTC	GAG	CTG	GAC	480
Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	
145				150					155					160		
GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	GAG	GGC	GAG	GGC	528
Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	
			165				170						175			
GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	TGC	ACC	ACC	GGC	576
Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	
		180					185					190				
AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	CTG	ACC	TAC	GGC	624
Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	
	195					200						205				
GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	CAG	CAC	GAC	TTC	672
Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	
	210				215					220						
TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	CGC	ACC	ATC	TTC	720
Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg	Thr	Ile	Phe	
225				230					235					240		

TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG	768
Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu	
245 250 255	
GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG	816
Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys	
260 265 270	
GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC	864
Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser	
275 280 285	
CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG	912
His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val	
290 295 300	
AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC	960
Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala	
305 310 315 320	
GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG	1008
Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu	
325 330 335	
CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC	1056
Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro	
340 345 350	
AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC	1104
Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala	
355 360 365	
GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA	1140
Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys	
370 375	

## (2) INFORMATION FOR SEQ ID NO:129:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 379 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:129:

Met Asp His Tyr Asp Ser Gln Gln Thr Asn Asp Tyr Met Gln Pro Glu	
1 5 10 15	
Glu Asp Trp Asp Arg Asp Leu Leu Leu Asp Pro Ala Trp Glu Lys Gln	
20 25 30	
Gln Arg Lys Thr Phe Thr Ala Trp Cys Asn Ser His Leu Arg Lys Ala	
35 40 45	
Gly Thr Gln Ile Glu Asn Ile Glu Glu Asp Phe Arg Asp Gly Leu Lys	

50		55		60
Leu Met Leu Leu Leu Glu Val Ile Ser Gly Glu Arg Leu Ala Lys Pro				
65		70		75
Glu Arg Gly Lys Met Arg Val His Lys Ile Ser Asn Val Asn Lys Ala				80
	85		90	95
Leu Asp Phe Ile Ala Ser Lys Gly Val Lys Leu Val Ser Ile Gly Ala				
	100		105	110
Glu Glu Ile Val Asp Gly Asn Val Lys Met Thr Leu Gly Met Ile Trp				
	115		120	125
Thr Ile Ile Leu Arg Arg Asp Pro Pro Val Ala Thr Met Val Ser Lys				
	130		135	140
Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp				
145		150		155
Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly				160
	165		170	175
Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly				
	180		185	190
Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly				
	195		200	205
Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe				
	210		215	220
Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe				
225		230		235
Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu				
	245		250	255
Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys				
	260		265	270
Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser				
	275		280	285
His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val				
	290		295	300
Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala				
305		310		315
Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu				
	325		330	335
Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro				
	340		345	350
Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala				
	355		360	365
Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys				
370		375		

## (2) INFORMATION FOR SEQ ID NO:130:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 3516 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...3513
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:130:

ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG	48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC	96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC	144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC	192
Cys Thr Thr Gly Lys Leu Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG	240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65 70 75 80	
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG	288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85 90 95	
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG	336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu	
100 105 110	
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC	384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly	
115 120 125	
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGC CAC AAG CTG GAG TAC	432
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr	
130 135 140	
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC	480
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn	
145 150 155 160	
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC	528
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser	
165 170 175	
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC	576
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly	
180 185 190	
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG	624
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu	
195 200 205	
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC	672
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe	
210 215 220	
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC	720



ATA ATG TCA CCT CGA ACC AGC CTC GCC GAG GAC AGC TGC CTG GGC CGC	1440
Ile Met Ser Pro Arg Thr Ser Leu Ala Glu Asp Ser Cys Leu Gly Arg	
465 470 475 480	
CAC TCG CCC GTG CCC CGT CCG GCC TCC CGC TCC TCA TCG CCT GGT GCC	1488
His Ser Pro Val Pro Arg Pro Ala Ser Arg Ser Ser Ser Pro Gly Ala	
485 490 495	
AAG CGG AGG CAT TCG TGC GCC GAG GCC TTG GTT GCC CTG CCG CCC GGA	1536
Lys Arg Arg His Ser Cys Ala Glu Ala Leu Val Ala Leu Pro Pro Gly	
500 505 510	
GCC TCA CCC CAG CGC TCC CGG AGC CCC TCG CCG CAG CCC TCA TCT CAC	1584
Ala Ser Pro Gln Arg Ser Arg Ser Pro Ser Pro Gln Pro Ser Ser His	
515 520 525	
GTG GCA CCC CAG GAC CAC GGC TCC CCG GCT GGG TAC CCC CCT GTG GCT	1632
Val Ala Pro Gln Asp His Gly Ser Pro Ala Gly Tyr Pro Pro Val Ala	
530 535 540	
GGC TCT GCC GTG ATC ATG GAT GCC CTG AAC AGC CTC GCC ACG GAC TCG	1680
Gly Ser Ala Val Ile Met Asp Ala Leu Asn Ser Leu Ala Thr Asp Ser	
545 550 555 560	
CCT TGT GGG ATC CCC CCC AAG ATG TGG AAG ACC AGC CCT GAC CCC TCG	1728
Pro Cys Gly Ile Pro Pro Lys Met Trp Lys Thr Ser Pro Asp Pro Ser	
565 570 575	
CCG GTG TCT GCC GCC CCA TCC AAG GCC GGC CTG CCT CGC CAC ATC TAC	1776
Pro Val Ser Ala Ala Pro Ser Lys Ala Gly Leu Pro Arg His Ile Tyr	
580 585 590	
CCG GCC GTG GAG TTC CTG GGG CCC TGC GAG CAG GGC GAG AGG AGA AAC	1824
Pro Ala Val Glu Phe Leu Gly Pro Cys Glu Gln Gly Glu Arg Arg Asn	
595 600 605	
TCG GCT CCA GAA TCC ATC CTG CTG GTT CCG CCC ACT TGG CCC AAG CCG	1872
Ser Ala Pro Glu Ser Ile Leu Leu Val Pro Pro Thr Trp Pro Lys Pro	
610 615 620	
CTG GTG CCT GCC ATT CCC ATC TGC AGC ATC CCA GTG ACT GCA TCC CTC	1920
Leu Val Pro Ala Ile Pro Ile Cys Ser Ile Pro Val Thr Ala Ser Leu	
625 630 635 640	
CCT CCA CTT GAG TGG CCG CTG TCC AGT CAG TCA GGC TCT TAC GAG CTG	1968
Pro Pro Leu Glu Trp Pro Leu Ser Ser Gln Ser Gly Ser Tyr Glu Leu	
645 650 655	
CGG ATC GAG GTG CAG CCC AAG CCA CAT CAC CGG GCC CAC TAT GAG ACA	2016
Arg Ile Glu Val Gln Pro Lys Pro His His Arg Ala His Tyr Glu Thr	
660 665 670	
GAA GGC AGC CGA GGG GCT GTC AAA GCT CCA ACT GGA GGC CAC CCT GTG	2064
Glu Gly Ser Arg Gly Ala Val Lys Ala Pro Thr Gly Gly His Pro Val	
675 680 685	
GTT CAG CTC CAT GGC TAC ATG GAA AAC AAG CCT CTG GGA CTT CAG ATC	2112



Val	Gln	Leu	His	Gly	Tyr	Met	Glu	Asn	Lys	Pro	Leu	Gly	Leu	Gln	Ile	
690						695				700						
TTC	ATT	GGG	ACA	GCT	GAT	GAG	CGG	ATC	CTT	AAG	CCG	CAC	GCC	TTC	TAC	2160
Phe	Ile	Gly	Thr	Ala	Asp	Glu	Arg	Ile	Leu	Lys	Pro	His	Ala	Phe	Tyr	
705					710				715						720	
CAG	GTG	CAC	CGA	ATC	ACG	GGG	AAA	ACT	GTC	ACC	ACC	ACC	AGC	TAT	GAG	2208
Gln	Val	His	Arg	Ile	Thr	Gly	Lys	Thr	Val	Thr	Thr	Thr	Ser	Tyr	Glu	
				725					730						735	
AAG	ATA	GTG	GGC	AAC	ACC	AAA	GTC	CTG	GAG	ATC	CCC	TTG	GAG	CCC	AAA	2256
Lys	Ile	Val	Gly	Asn	Thr	Lys	Val	Leu	Glu	Ile	Pro	Leu	Glu	Pro	Lys	
			740					745					750			
AAC	AAC	ATG	AGG	GCA	ACC	ATC	GAC	TGT	GCG	GGG	ATC	TTG	AAG	CTT	AGA	2304
Asn	Asn	Met	Arg	Ala	Thr	Ile	Asp	Cys	Ala	Gly	Ile	Leu	Lys	Leu	Arg	
		755					760					765				
AAC	GCC	GAC	ATT	GAG	CTG	CGG	AAA	GGC	GAG	ACG	GAC	ATT	GGA	AGA	AAG	2352
Asn	Ala	Asp	Ile	Glu	Leu	Arg	Lys	Gly	Glu	Thr	Asp	Ile	Gly	Arg	Lys	
	770					775					780					
AAC	ACG	CGG	GTG	AGA	CTG	GTT	TTC	CGA	GTT	CAC	ATC	CCA	GAG	TCC	AGT	2400
Asn	Thr	Arg	Val	Arg	Leu	Val	Phe	Arg	Val	His	Ile	Pro	Glu	Ser	Ser	
	785				790					795					800	
GGC	AGA	ATC	GTC	TCT	TTA	CAG	ACT	GCA	TCT	AAC	CCC	ATC	GAG	TGC	TCC	2448
Gly	Arg	Ile	Val	Ser	Leu	Gln	Thr	Ala	Ser	Asn	Pro	Ile	Glu	Cys	Ser	
			805						810					815		
CAG	CGA	TCT	GCT	CAC	GAG	CTG	CCC	ATG	GTT	GAA	AGA	CAA	GAC	ACA	GAC	2496
Gln	Arg	Ser	Ala	His	Glu	Leu	Pro	Met	Val	Glu	Arg	Gln	Asp	Thr	Asp	
			820					825					830			
AGC	TGC	CTG	GTC	TAT	GGC	GGC	CAG	CAA	ATG	ATC	CTC	ACG	GGG	CAG	AAC	2544
Ser	Cys	Leu	Val	Tyr	Gly	Gly	Gln	Gln	Met	Ile	Leu	Thr	Gly	Gln	Asn	
		835					840					845				
TTT	ACA	TCC	GAG	TCC	AAA	GTT	GTG	TTT	ACT	GAG	AAG	ACC	ACA	GAT	GGA	2592
Phe	Thr	Ser	Glu	Ser	Lys	Val	Val	Phe	Thr	Glu	Lys	Thr	Thr	Asp	Gly	
	850					855					860					
CAG	CAA	ATT	TGG	GAG	ATG	GAA	GCC	ACG	GTG	GAT	AAG	GAC	AAG	AGC	CAG	2640
Gln	Gln	Ile	Trp	Glu	Met	Glu	Ala	Thr	Val	Asp	Lys	Asp	Lys	Ser	Gln	
	865				870					875					880	
CCC	AAC	ATG	CTT	TTT	GTT	GAG	ATC	CCT	GAA	TAT	CGG	AAC	AAG	CAT	ATC	2688
Pro	Asn	Met	Leu	Phe	Val	Glu	Ile	Pro	Glu	Tyr	Arg	Asn	Lys	His	Ile	
			885					890						895		
CGC	ACA	CCT	GTA	AAA	GTG	AAC	TTC	TAC	GTC	ATC	AAT	GGG	AAG	AGA	AAA	2736
Arg	Thr	Pro	Val	Lys	Val	Asn	Phe	Tyr	Val	Ile	Asn	Gly	Lys	Arg	Lys	
		900						905					910			
CGA	AGT	CAG	CCT	CAG	CAC	TTT	ACC	TAC	CAC	CCA	GTC	CCA	GCC	ATC	AAG	2784
Arg	Ser	Gln	Pro	Gln	His	Phe	Thr	Tyr	His	Pro	Val	Pro	Ala	Ile	Lys	
		915					920						925			

ACG GAG CCC ACG GAT GAA TAT GAC CCC ACT CTG ATC TGC AGC CCC ACC Thr Glu Pro Thr Asp Glu Tyr Asp Pro Thr Leu Ile Cys Ser Pro Thr 930 935 940	2832
CAT GGA GGC CTG GGG AGC CAG CCT TAC TAC CCC CAG CAC CCG ATG GTG His Gly Gly Leu Gly Ser Gln Pro Tyr Tyr Pro Gln His Pro Met Val 945 950 955 960	2880
GCC GAG TCC CCC TCC TGC CTC GTG GCC ACC ATG GCT CCC TGC CAG CAG Ala Glu Ser Pro Ser Cys Leu Val Ala Thr Met Ala Pro Cys Gln Gln 965 970 975	2928
TTC CGC ACG GGG CTC TCA TCC CCT GAC GCC CGC TAC CAG CAA CAG AAC Phe Arg Thr Gly Leu Ser Ser Pro Asp Ala Arg Tyr Gln Gln Gln Asn 980 985 990	2976
CCA GCG GCC GTA CTC TAC CAG CGG AGC AAG AGC CTG AGC CCC AGC CTG Pro Ala Ala Val Leu Tyr Gln Arg Ser Lys Ser Leu Ser Pro Ser Leu 995 1000 1005	3024
CTG GGC TAT CAG CAG CCG GCC CTC ATG GCC GCC CCG CTG TCC CTT GCG Leu Gly Tyr Gln Gln Pro Ala Leu Met Ala Ala Pro Leu Ser Leu Ala 1010 1015 1020	3072
GAC GCT CAC CGC TCT GTG CTG GTG CAC GCC GGC TCC CAG GGC CAG AGC Asp Ala His Arg Ser Val Leu Val His Ala Gly Ser Gln Gly Gln Ser 1025 1030 1035 1040	3120
TCA GCC CTG CTC CAC CCC TCT CCG ACC AAC CAG CAG GCC TCG CCT GTG Ser Ala Leu Leu His Pro Ser Pro Thr Asn Gln Gln Ala Ser Pro Val 1045 1050 1055	3168
ATC CAC TAC TCA CCC ACC AAC CAG CAG CTG CGC TGC GGA AGC CAC CAG Ile His Tyr Ser Pro Thr Asn Gln Gln Leu Arg Cys Gly Ser His Gln 1060 1065 1070	3216
GAG TTC CAG CAC ATC ATG TAC TGC GAG AAT TTC GCA CCA GGC ACC ACC Glu Phe Gln His Ile Met Tyr Cys Glu Asn Phe Ala Pro Gly Thr Thr 1075 1080 1085	3264
AGA CCT GGC CCG CCC CCG GTC AGT CAA GGT CAG AGG CTG AGC CCG GGT Arg Pro Gly Pro Pro Val Ser Gln Gly Gln Arg Leu Ser Pro Gly 1090 1095 1100	3312
TCC TAC CCC ACA GTC ATT CAG CAG CAG AAT GCC ACG AGC CAA AGA GCC Ser Tyr Pro Thr Val Ile Gln Gln Gln Asn Ala Thr Ser Gln Arg Ala 1105 1110 1115 1120	3360
GCC AAA AAC GGA CCC CCG GTC AGT GAC CAA AAG GAA GTA TTA CCT GCG Ala Lys Asn Gly Pro Pro Val Ser Asp Gln Lys Glu Val Leu Pro Ala 1125 1130 1135	3408
GGG GTG ACC ATT AAA CAG GAG CAG AAC TTG GAC CAG ACC TAC TTG GAT Gly Val Thr Ile Lys Gln Glu Gln Asn Leu Asp Gln Thr Tyr Leu Asp 1140 1145 1150	3456
GAT GTT AAT GAA ATT ATC AGG AAG GAG TTT TCA GGA CCT CCT GCC AGA	3504

Asp Val Asn Glu Ile Ile Arg Lys Glu Phe Ser Gly Pro Pro Ala Arg  
 1155 1160 1165

AAT CAG ACG TAA  
 Asn Gln Thr  
 1170

3516

## (2) INFORMATION FOR SEQ ID NO:131:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1171 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:131:

Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	1	5	10	15
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	20	25	30	
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	35	40	45	
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	50	55	60	
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	65	70	75	80
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	85	90	95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	100	105	110	
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	115	120	125	
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	130	135	140	
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	145	150	155	160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	165	170	175	
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	180	185	190	
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	195	200	205	
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	210	215	220	
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	225	230	235	240
Gly	Leu	Arg	Ser	Arg	Ala	Met	Asn	Ala	Pro	Glu	Arg	Gln	Pro	Gln	Pro	245	250	255	
Asp	Gly	Gly	Asp	Ala	Pro	Gly	His	Glu	Pro	Gly	Gly	Ser	Pro	Gln	Asp	260	265	270	
Glu	Leu	Asp	Phe	Ser	Ile	Leu	Phe	Asp	Tyr	Glu	Tyr	Leu	Asn	Pro	Asn	275	280	285	
Glu	Glu	Glu	Pro	Asn	Ala	His	Lys	Val	Ala	Ser	Pro	Pro	Ser	Gly	Pro				

290	295	300
Ala Tyr Pro Asp Asp Val Met Asp Tyr Gly Leu Lys Pro Tyr Ser Pro		
305	310	315
Leu Ala Ser Leu Ser Gly Glu Pro Pro Gly Arg Phe Gly Glu Pro Asp		320
	325	330
Arg Val Gly Pro Gln Lys Phe Leu Ser Ala Ala Lys Pro Ala Gly Ala		335
	340	345
Ser Gly Leu Ser Pro Arg Ile Glu Ile Thr Pro Ser His Glu Leu Ile		350
	355	360
Gln Ala Val Gly Pro Leu Arg Met Arg Asp Ala Gly Leu Leu Val Glu		365
	370	375
Gln Pro Pro Leu Ala Gly Val Ala Ala Ser Pro Arg Phe Thr Leu Pro		380
385	390	395
Val Pro Gly Phe Glu Gly Tyr Arg Glu Pro Leu Cys Leu Ser Pro Ala		400
	405	410
Ser Ser Gly Ser Ser Ala Ser Phe Ile Ser Asp Thr Phe Ser Pro Tyr		415
	420	425
Thr Ser Pro Cys Val Ser Pro Asn Asn Gly Gly Pro Asp Asp Leu Cys		430
	435	440
Pro Gln Phe Gln Asn Ile Pro Ala His Tyr Ser Pro Arg Thr Ser Pro		445
	450	455
Ile Met Ser Pro Arg Thr Ser Leu Ala Glu Asp Ser Cys Leu Gly Arg		460
465	470	475
His Ser Pro Val Pro Arg Pro Ala Ser Arg Ser Ser Ser Pro Gly Ala		480
	485	490
Lys Arg Arg His Ser Cys Ala Glu Ala Leu Val Ala Leu Pro Pro Gly		495
	500	505
Ala Ser Pro Gln Arg Ser Arg Ser Pro Ser Pro Gln Pro Ser Ser His		510
	515	520
Val Ala Pro Gln Asp His Gly Ser Pro Ala Gly Tyr Pro Pro Val Ala		525
	530	535
Gly Ser Ala Val Ile Met Asp Ala Leu Asn Ser Leu Ala Thr Asp Ser		540
545	550	555
Pro Cys Gly Ile Pro Pro Lys Met Trp Lys Thr Ser Pro Asp Pro Ser		560
	565	570
Pro Val Ser Ala Ala Pro Ser Lys Ala Gly Leu Pro Arg His Ile Tyr		575
	580	585
Pro Ala Val Glu Phe Leu Gly Pro Cys Glu Gln Gly Glu Arg Arg Asn		590
	595	600
Ser Ala Pro Glu Ser Ile Leu Leu Val Pro Pro Thr Trp Pro Lys Pro		605
	610	615
Leu Val Pro Ala Ile Pro Ile Cys Ser Ile Pro Val Thr Ala Ser Leu		620
625	630	635
Pro Pro Leu Glu Trp Pro Leu Ser Ser Gln Ser Gly Ser Tyr Glu Leu		640
	645	650
Arg Ile Glu Val Gln Pro Lys Pro His His Arg Ala His Tyr Glu Thr		655
	660	665
Glu Gly Ser Arg Gly Ala Val Lys Ala Pro Thr Gly Gly His Pro Val		670
	675	680
Val Gln Leu His Gly Tyr Met Glu Asn Lys Pro Leu Gly Leu Gln Ile		685
	690	695
Phe Ile Gly Thr Ala Asp Glu Arg Ile Leu Lys Pro His Ala Phe Tyr		700
705	710	715
Gln Val His Arg Ile Thr Gly Lys Thr Val Thr Thr Thr Ser Tyr Glu		720
	725	730
Lys Ile Val Gly Asn Thr Lys Val Leu Glu Ile Pro Leu Glu Pro Lys		735
	740	745
Asn Asn Met Arg Ala Thr Ile Asp Cys Ala Gly Ile Leu Lys Leu Arg		750

755	760	765
Asn Ala Asp Ile Glu Leu Arg Lys Gly Glu Thr Asp Ile Gly Arg Lys		
770	775	780
Asn Thr Arg Val Arg Leu Val Phe Arg Val His Ile Pro Glu Ser Ser		
785	790	795
Gly Arg Ile Val Ser Leu Gln Thr Ala Ser Asn Pro Ile Glu Cys Ser		800
	805	810
Gln Arg Ser Ala His Glu Leu Pro Met Val Glu Arg Gln Asp Thr Asp		815
	820	825
Ser Cys Leu Val Tyr Gly Gly Gln Gln Met Ile Leu Thr Gly Gln Asn		830
	835	840
Phe Thr Ser Glu Ser Lys Val Val Phe Thr Glu Lys Thr Thr Asp Gly		845
	850	855
Gln Gln Ile Trp Glu Met Glu Ala Thr Val Asp Lys Asp Lys Ser Gln		860
865	870	875
Pro Asn Met Leu Phe Val Glu Ile Pro Glu Tyr Arg Asn Lys His Ile		880
	885	890
Arg Thr Pro Val Lys Val Asn Phe Tyr Val Ile Asn Gly Lys Arg Lys		895
	900	905
Arg Ser Gln Pro Gln His Phe Thr Tyr His Pro Val Pro Ala Ile Lys		910
	915	920
Thr Glu Pro Thr Asp Glu Tyr Asp Pro Thr Leu Ile Cys Ser Pro Thr		925
	930	935
His Gly Gly Leu Gly Ser Gln Pro Tyr Tyr Pro Gln His Pro Met Val		940
945	950	955
Ala Glu Ser Pro Ser Cys Leu Val Ala Thr Met Ala Pro Cys Gln Gln		960
	965	970
Phe Arg Thr Gly Leu Ser Ser Pro Asp Ala Arg Tyr Gln Gln Gln Asn		975
	980	985
Pro Ala Ala Val Leu Tyr Gln Arg Ser Lys Ser Leu Ser Pro Ser Leu		990
	995	1000
Leu Gly Tyr Gln Gln Pro Ala Leu Met Ala Ala Pro Leu Ser Leu Ala		1005
	1010	1015
Asp Ala His Arg Ser Val Leu Val His Ala Gly Ser Gln Gly Gln Ser		1020
025	1030	1035
Ser Ala Leu Leu His Pro Ser Pro Thr Asn Gln Gln Ala Ser Pro Val		1040
	1045	1050
Ile His Tyr Ser Pro Thr Asn Gln Gln Leu Arg Cys Gly Ser His Gln		1055
	1060	1065
Glu Phe Gln His Ile Met Tyr Cys Glu Asn Phe Ala Pro Gly Thr Thr		1070
	1075	1080
Arg Pro Gly Pro Pro Pro Val Ser Gln Gly Gln Arg Leu Ser Pro Gly		1085
	1090	1095
Ser Tyr Pro Thr Val Ile Gln Gln Gln Asn Ala Thr Ser Gln Arg Ala		1100
105	1110	1115
Ala Lys Asn Gly Pro Pro Val Ser Asp Gln Lys Glu Val Leu Pro Ala		1120
	1125	1130
Gly Val Thr Ile Lys Gln Glu Gln Asn Leu Asp Gln Thr Tyr Leu Asp		1135
	1140	1145
Asp Val Asn Glu Ile Ile Arg Lys Glu Phe Ser Gly Pro Pro Ala Arg		1150
	1155	1160
Asn Gln Thr		1165
1170		

(2) INFORMATION FOR SEQ ID NO:132:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 3546 base pairs

(B) TYPE: nucleic acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA  
 (ix) FEATURE:

(A) NAME/KEY: Coding Sequence  
 (B) LOCATION: 1...3543  
 (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:132:

ATG AAC GCC CCC GAG CGG CAG CCC CAA CCC GAC GGC GGG GAC GCC CCA	48
Met Asn Ala Pro Glu Arg Gln Pro Gln Pro Asp Gly Gly Asp Ala Pro	
1 5 10 15	
GGC CAC GAG CCT GGG GGC AGC CCC CAA GAC GAG CTT GAC TTC TCC ATC	96
Gly His Glu Pro Gly Gly Ser Pro Gln Asp Glu Leu Asp Phe Ser Ile	
20 25 30	
CTC TTC GAC TAT GAG TAT TTG AAT CCG AAC GAA GAA GAG CCG AAT GCA	144
Leu Phe Asp Tyr Glu Tyr Leu Asn Pro Asn Glu Glu Pro Asn Ala	
35 40 45	
CAT AAG GTC GCC AGC CCA CCC TCC GGA CCC GCA TAC CCC GAT GAT GTA	192
His Lys Val Ala Ser Pro Pro Ser Gly Pro Ala Tyr Pro Asp Asp Val	
50 55 60	
ATG GAC TAT GGC CTC AAG CCA TAC AGC CCC CTT GCT AGT CTC TCT GGC	240
Met Asp Tyr Gly Leu Lys Pro Tyr Ser Pro Leu Ala Ser Leu Ser Gly	
65 70 75 80	
GAG CCC CCC GGC CGA TTC GGA GAG CCG GAT AGG GTA GGG CCG CAG AAG	288
Glu Pro Pro Gly Arg Phe Gly Glu Pro Asp Arg Val Gly Pro Gln Lys	
85 90 95	
TTT CTG AGC GCG GCC AAG CCA GCA GGG GCC TCG GGC CTG AGC CCT CGG	336
Phe Leu Ser Ala Ala Lys Pro Ala Gly Ala Ser Gly Leu Ser Pro Arg	
100 105 110	
ATC GAG ATC ACT CCG TCC CAC GAA CTG ATC CAG GCA GTG GGG CCC CTC	384
Ile Glu Ile Thr Pro Ser His Glu Leu Ile Gln Ala Val Gly Pro Leu	
115 120 125	
CGC ATG AGA GAC GCG GGC CTC CTG GTG GAG CAG CCT CCC CTG GCC GGG	432
Arg Met Arg Asp Ala Gly Leu Leu Val Glu Gln Pro Pro Leu Ala Gly	
130 135 140	
GTG GCC GCC AGC CCG AGG TTC ACC CTG CCC GTG CCC GGC TTC GAG GGC	480
Val Ala Ala Ser Pro Arg Phe Thr Leu Pro Val Pro Gly Phe Glu Gly	
145 150 155 160	
TAC CGC GAG CCG CTT TGC TTG AGC CCC GCT AGC AGC GGC TCC TCT GCC	528
Tyr Arg Glu Pro Leu Cys Leu Ser Pro Ala Ser Ser Gly Ser Ser Ala	
165 170 175	
AGC TTC ATT TCT GAC ACC TTC TCC CCC TAC ACC TCG CCC TGC GTC TCG	576

Ser	Phe	Ile	Ser	Asp	Thr	Phe	Ser	Pro	Tyr	Thr	Ser	Pro	Cys	Val	Ser	
			180				185						190			
CCC Pro	AAT Asn	AAC Asn	GGC Gly	GGG Gly	CCC Pro	GAC Asp	GAC Asp	CTG Leu	TGT Cys	CCG Pro	CAG Gln	TTT Phe	CAA Gln	AAC Asn	ATC Ile	624
			195				200						205			
CCT Pro	GCT Ala	CAT His	TAT Tyr	TCC Ser	CCC Pro	AGA Arg	ACC Thr	TCG Ser	CCA Pro	ATA Ile	ATG Met	TCA Ser	CCT Pro	CGA Arg	ACC Thr	672
			210				215						220			
AGC Ser	CTC Leu	GCC Ala	GAG Glu	GAC Asp	AGC Ser	TGC Cys	CTG Leu	GGC Gly	CGC Arg	CAC His	TCG Ser	CCC Pro	GTG Val	CCC Pro	CGT Arg	720
			225				230						235			240
CCG Pro	GCC Ala	TCC Ser	CGC Arg	TCC Ser	TCA Ser	TCG Ser	CCT Pro	GGT Gly	GCC Ala	AAG Lys	CGG Arg	AGG Arg	CAT His	TCG Ser	TGC Cys	768
			245							250			255			
GCC Ala	GAG Glu	GCC Ala	TTG Leu	GTT Val	GCC Ala	CTG Leu	CCG Pro	CCC Pro	GGA Gly	GCC Ala	TCA Ser	CCC Pro	CAG Gln	CGC Arg	TCC Ser	816
			260							265			270			
CGG Arg	AGC Ser	CCC Pro	TCG Ser	CCG Pro	CAG Gln	CCC Pro	TCA Ser	TCT Ser	CAC His	GTG Val	GCA Ala	CCC Pro	CAG Gln	GAC Asp	CAC His	864
			275				280						285			
GGC Gly	TCC Ser	CCG Pro	GCT Ala	GGG Gly	TAC Tyr	CCC Pro	CCT Pro	GTG Val	GCT Ala	GGC Gly	TCT Ser	GCC Ala	GTG Val	ATC Ile	ATG Met	912
			290				295						300			
GAT Asp	GCC Ala	CTG Leu	AAC Asn	AGC Ser	CTC Leu	GCC Ala	ACG Thr	GAC Asp	TCG Ser	CCT Pro	TGT Cys	GGG Gly	ATC Ile	CCC Pro	CCC Pro	960
			305				310						315			320
AAG Lys	ATG Met	TGG Trp	AAG Lys	ACC Thr	AGC Ser	CCT Pro	GAC Asp	CCC Pro	TCG Ser	CCG Pro	GTG Val	TCT Ser	GCC Ala	GCC Ala	CCA Pro	1008
			325							330			335			
TCC Ser	AAG Lys	GCC Ala	GGC Gly	CTG Leu	CCT Pro	CGC Arg	CAC His	ATC Ile	TAC Tyr	CCG Pro	GCC Ala	GTG Val	GAG Glu	TTC Phe	CTG Leu	1056
			340				345						350			
GGG Gly	CCC Pro	TGC Cys	GAG Glu	CAG Gln	GGC Gly	GAG Glu	AGG Arg	AGA Arg	AAC Asn	TCG Ser	GCT Ala	CCA Pro	GAA Glu	TCC Ser	ATC Ile	1104
			355				360						365			
CTG Leu	CTG Leu	GTT Val	CCG Pro	CCC Pro	ACT Thr	TGG Trp	CCC Pro	AAG Lys	CCG Pro	CTG Leu	GTG Val	CCT Pro	GCC Ala	ATT Ile	CCC Pro	1152
			370				375						380			
ATC Ile	TGC Cys	AGC Ser	ATC Ile	CCA Pro	GTG Val	ACT Thr	GCA Ala	TCC Ser	CTC Leu	CCT Pro	CCA Pro	CTT Leu	GAG Glu	TGG Trp	CCG Pro	1200
			385				390						395			400
CTG Leu	TCC Ser	AGT Ser	CAG Gln	TCA Ser	GGC Gly	TCT Ser	TAC Tyr	GAG Glu	CTG Leu	CGG Arg	ATC Ile	GAG Glu	GTG Val	CAG Gln	CCC Pro	1248
			405							410			415			

AAG CCA CAT CAC CGG GCC CAC TAT GAG ACA GAA GGC AGC CGA GGG GCT	1296
Lys Pro His His Arg Ala His Tyr Glu Thr Glu Gly Ser Arg Gly Ala	
420 425 430	
GTC AAA GCT CCA ACT GGA GGC CAC CCT GTG GTT CAG CTC CAT GGC TAC	1344
Val Lys Ala Pro Thr Gly Gly His Pro Val Val Gln Leu His Gly Tyr	
435 440 445	
ATG GAA AAC AAG CCT CTG GGA CTT CAG ATC TTC ATT GGG ACA GCT GAT	1392
Met Glu Asn Lys Pro Leu Gly Leu Gln Ile Phe Ile Gly Thr Ala Asp	
450 455 460	
GAG CGG ATC CTT AAG CCG CAC GCC TTC TAC CAG GTG CAC CGA ATC ACG	1440
Glu Arg Ile Leu Lys Pro His Ala Phe Tyr Gln Val His Arg Ile Thr	
465 470 475 480	
GGG AAA ACT GTC ACC ACC ACC AGC TAT GAG AAG ATA GTG GGC AAC ACC	1488
Gly Lys Thr Val Thr Thr Ser Tyr Glu Lys Ile Val Gly Asn Thr	
485 490 495	
AAA GTC CTG GAG ATC CCC TTG GAG CCC AAA AAC AAC ATG AGG GCA ACC	1536
Lys Val Leu Glu Ile Pro Leu Glu Pro Lys Asn Asn Met Arg Ala Thr	
500 505 510	
ATC GAC TGT GCG GGG ATC TTG AAG CTT AGA AAC GCC GAC ATT GAG CTG	1584
Ile Asp Cys Ala Gly Ile Leu Lys Leu Arg Asn Ala Asp Ile Glu Leu	
515 520 525	
CGG AAA GGC GAG ACG GAC ATT GGA AGA AAG AAC ACG CGG GTG AGA CTG	1632
Arg Lys Gly Glu Thr Asp Ile Gly Arg Lys Asn Thr Arg Val Arg Leu	
530 535 540	
GTT TTC CGA GTT CAC ATC CCA GAG TCC AGT GGC AGA ATC GTC TCT TTA	1680
Val Phe Arg Val His Ile Pro Glu Ser Ser Gly Arg Ile Val Ser Leu	
545 550 555 560	
CAG ACT GCA TCT AAC CCC ATC GAG TGC TCC CAG CGA TCT GCT CAC GAG	1728
Gln Thr Ala Ser Asn Pro Ile Glu Cys Ser Gln Arg Ser Ala His Glu	
565 570 575	
CTG CCC ATG GTT GAA AGA CAA GAC ACA GAC AGC TGC CTG GTC TAT GGC	1776
Leu Pro Met Val Glu Arg Gln Asp Thr Asp Ser Cys Leu Val Tyr Gly	
580 585 590	
GGC CAG CAA ATG ATC CTC ACG GGG CAG AAC TTT ACA TCC GAG TCC AAA	1824
Gly Gln Gln Met Ile Leu Thr Gly Gln Asn Phe Thr Ser Glu Ser Lys	
595 600 605	
GTT GTG TTT ACT GAG AAG ACC ACA GAT GGA CAG CAA ATT TGG GAG ATG	1872
Val Val Phe Thr Glu Lys Thr Thr Asp Gly Gln Gln Ile Trp Glu Met	
610 615 620	
GAA GCC ACG GTG GAT AAG GAC AAG AGC CAG CCC AAC ATG CTT TTT GTT	1920
Glu Ala Thr Val Asp Lys Asp Lys Ser Gln Pro Asn Met Leu Phe Val	
625 630 635 640	
GAG ATC CCT GAA TAT CGG AAC AAG CAT ATC CGC ACA CCT GTA AAA GTG	1968



Glu Ile Pro Glu Tyr Arg Asn Lys His Ile Arg Thr Pro Val Lys Val	
645 650 655	
AAC TTC TAC GTC ATC AAT GGG AAG AGA AAA CGA AGT CAG CCT CAG CAC	2016
Asn Phe Tyr Val Ile Asn Gly Lys Arg Lys Arg Ser Gln Pro Gln His	
660 665 670	
TTT ACC TAC CAC CCA GTC CCA GCC ATC AAG ACG GAG CCC ACG GAT GAA	2064
Phe Thr Tyr His Pro Val Pro Ala Ile Lys Thr Glu Pro Thr Asp Glu	
675 680 685	
TAT GAC CCC ACT CTG ATC TGC AGC CCC ACC CAT GGA GGC CTG GGG AGC	2112
Tyr Asp Pro Thr Leu Ile Cys Ser Pro Thr His Gly Gly Leu Gly Ser	
690 695 700	
CAG CCT TAC TAC CCC CAG CAC CCG ATG GTG GCC GAG TCC CCC TCC TGC	2160
Gln Pro Tyr Tyr Pro Gln His Pro Met Val Ala Glu Ser Pro Ser Cys	
705 710 715 720	
CTC GTG GCC ACC ATG GCT CCC TGC CAG CAG TTC CGC ACG GGG CTC TCA	2208
Leu Val Ala Thr Met Ala Pro Cys Gln Gln Phe Arg Thr Gly Leu Ser	
725 730 735	
TCC CCT GAC GCC CGC TAC CAG CAA CAG AAC CCA GCG GCC GTA CTC TAC	2256
Ser Pro Asp Ala Arg Tyr Gln Gln Asn Pro Ala Ala Val Leu Tyr	
740 745 750	
CAG CGG AGC AAG AGC CTG AGC CCC AGC CTG CTG GGC TAT CAG CAG CCG	2304
Gln Arg Ser Lys Ser Leu Ser Pro Ser Leu Leu Gly Tyr Gln Gln Pro	
755 760 765	
GCC CTC ATG GCC GCC CCG CTG TCC CTT GCG GAC GCT CAC CGC TCT GTG	2352
Ala Leu Met Ala Ala Pro Leu Ser Leu Ala Asp Ala His Arg Ser Val	
770 775 780	
CTG GTG CAC GCC GGC TCC CAG GGC CAG AGC TCA GCC CTG CTC CAC CCC	2400
Leu Val His Ala Gly Ser Gln Gly Gln Ser Ser Ala Leu Leu His Pro	
785 790 795 800	
TCT CCG ACC AAC CAG CAG GCC TCG CCT GTG ATC CAC TAC TCA CCC ACC	2448
Ser Pro Thr Asn Gln Gln Ala Ser Pro Val Ile His Tyr Ser Pro Thr	
805 810 815	
AAC CAG CAG CTG CGC TGC GGA AGC CAC CAG GAG TTC CAG CAC ATC ATG	2496
Asn Gln Gln Leu Arg Cys Gly Ser His Gln Glu Phe Gln His Ile Met	
820 825 830	
TAC TGC GAG AAT TTC GCA CCA GGC ACC ACC AGA CCT GGC CCG CCC CCG	2544
Tyr Cys Glu Asn Phe Ala Pro Gly Thr Thr Arg Pro Gly Pro Pro Pro	
835 840 845	
GTC AGT CAA GGT CAG AGG CTG AGC CCG GGT TCC TAC CCC ACA GTC ATT	2592
Val Ser Gln Gly Gln Arg Leu Ser Pro Gly Ser Tyr Pro Thr Val Ile	
850 855 860	
CAG CAG CAG AAT GCC ACG AGC CAA AGA GCC GCC AAA AAC GGA CCC CCG	2640
Gln Gln Gln Asn Ala Thr Ser Gln Arg Ala Lys Asn Gly Pro Pro	
865 870 875 880	

GTC AGT GAC CAA AAG GAA GTA TTA CCT GCG GGG GTG ACC ATT AAA CAG Val Ser Asp Gln Lys Glu Val Leu Pro Ala Gly Val Thr Ile Lys Gln 885 890 895	2688
GAG CAG AAC TTG GAC CAG ACC TAC TTG GAT GAT GTT AAT GAA ATT ATC Glu Gln Asn Leu Asp Gln Thr Tyr Leu Asp Asp Val Asn Glu Ile Ile 900 905 910	2736
AGG AAG GAG TTT TCA GGA CCT CCT GCC AGA AAT CAG ACG AGA ATT CTG Arg Lys Glu Phe Ser Gly Pro Ala Arg Asn Gln Thr Arg Ile Leu 915 920 925	2784
CAG TCG ACG GTA CCG CGG GCC CGG GAT CCA CCG GTC GCC ACC ATG GTG Gln Ser Thr Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr Met Val 930 935 940	2832
AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG GTC GAG Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu 945 950 955 960	2880
CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC GAG GGC Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly 965 970 975	2928
GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC TGC ACC Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr 980 985 990	2976
ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC CTG ACC Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr 995 1000 1005	3024
TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG CAG CAC Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His 1010 1015 1020	3072
GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC ACC Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr 1025 1030 1035 1040	3120
ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys 1045 1050 1055	3168
TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp 1060 1065 1070	3216
TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr 1075 1080 1085	3264
AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile 1090 1095 1100	3312
AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG	3360

Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln  
 1105 1110 1115 1120  
 CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG 3408  
 Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val  
 1125 1130 1135  
 CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA 3456  
 Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys  
 1140 1145 1150  
 GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC 3504  
 Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr  
 1155 1160 1165  
 GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA 3546  
 Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys  
 1170 1175 1180

## (2) INFORMATION FOR SEQ ID NO:133:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1181 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:133:

Met Asn Ala Pro Glu Arg Gln Pro Gln Pro Asp Gly Gly Asp Ala Pro  
 1 5 10 15  
 Gly His Glu Pro Gly Gly Ser Pro Gln Asp Glu Leu Asp Phe Ser Ile  
 20 25 30  
 Leu Phe Asp Tyr Glu Tyr Leu Asn Pro Asn Glu Glu Glu Pro Asn Ala  
 35 40 45  
 His Lys Val Ala Ser Pro Pro Ser Gly Pro Ala Tyr Pro Asp Asp Val  
 50 55 60  
 Met Asp Tyr Gly Leu Lys Pro Tyr Ser Pro Leu Ala Ser Leu Ser Gly  
 65 70 75 80  
 Glu Pro Pro Gly Arg Phe Gly Glu Pro Asp Arg Val Gly Pro Gln Lys  
 85 90 95  
 Phe Leu Ser Ala Ala Lys Pro Ala Gly Ala Ser Gly Leu Ser Pro Arg  
 100 105 110  
 Ile Glu Ile Thr Pro Ser His Glu Leu Ile Gln Ala Val Gly Pro Leu  
 115 120 125  
 Arg Met Arg Asp Ala Gly Leu Val Glu Gln Pro Pro Leu Ala Gly  
 130 135 140  
 Val Ala Ala Ser Pro Arg Phe Thr Leu Pro Val Pro Gly Phe Glu Gly  
 145 150 155 160  
 Tyr Arg Glu Pro Leu Cys Leu Ser Pro Ala Ser Ser Gly Ser Ser Ala  
 165 170 175  
 Ser Phe Ile Ser Asp Thr Phe Ser Pro Tyr Thr Ser Pro Cys Val Ser  
 180 185 190  
 Pro Asn Asn Gly Gly Pro Asp Asp Leu Cys Pro Gln Phe Gln Asn Ile

195                      200                      205  
 Pro Ala His Tyr Ser Pro Arg Thr Ser Pro Ile Met Ser Pro Arg Thr  
 210                      215                      220  
 Ser Leu Ala Glu Asp Ser Cys Leu Gly Arg His Ser Pro Val Pro Arg  
 225                      230                      235                      240  
 Pro Ala Ser Arg Ser Ser Ser Pro Gly Ala Lys Arg Arg His Ser Cys  
 245                      250                      255  
 Ala Glu Ala Leu Val Ala Leu Pro Pro Gly Ala Ser Pro Gln Arg Ser  
 260                      265                      270  
 Arg Ser Pro Ser Pro Gln Pro Ser Ser His Val Ala Pro Gln Asp His  
 275                      280                      285  
 Gly Ser Pro Ala Gly Tyr Pro Pro Val Ala Gly Ser Ala Val Ile Met  
 290                      295                      300  
 Asp Ala Leu Asn Ser Leu Ala Thr Asp Ser Pro Cys Gly Ile Pro Pro  
 305                      310                      315                      320  
 Lys Met Trp Lys Thr Ser Pro Asp Pro Ser Pro Val Ser Ala Ala Pro  
 325                      330                      335  
 Ser Lys Ala Gly Leu Pro Arg His Ile Tyr Pro Ala Val Glu Phe Leu  
 340                      345                      350  
 Gly Pro Cys Glu Gln Gly Glu Arg Arg Asn Ser Ala Pro Glu Ser Ile  
 355                      360                      365  
 Leu Leu Val Pro Pro Thr Trp Pro Lys Pro Leu Val Pro Ala Ile Pro  
 370                      375                      380  
 Ile Cys Ser Ile Pro Val Thr Ala Ser Leu Pro Pro Leu Glu Trp Pro  
 385                      390                      395                      400  
 Leu Ser Ser Gln Ser Gly Ser Tyr Glu Leu Arg Ile Glu Val Gln Pro  
 405                      410                      415  
 Lys Pro His His Arg Ala His Tyr Glu Thr Glu Gly Ser Arg Gly Ala  
 420                      425                      430  
 Val Lys Ala Pro Thr Gly Gly His Pro Val Val Gln Leu His Gly Tyr  
 435                      440                      445  
 Met Glu Asn Lys Pro Leu Gly Leu Gln Ile Phe Ile Gly Thr Ala Asp  
 450                      455                      460  
 Glu Arg Ile Leu Lys Pro His Ala Phe Tyr Gln Val His Arg Ile Thr  
 465                      470                      475                      480  
 Gly Lys Thr Val Thr Thr Thr Ser Tyr Glu Lys Ile Val Gly Asn Thr  
 485                      490                      495  
 Lys Val Leu Glu Ile Pro Leu Glu Pro Lys Asn Asn Met Arg Ala Thr  
 500                      505                      510  
 Ile Asp Cys Ala Gly Ile Leu Lys Leu Arg Asn Ala Asp Ile Glu Leu  
 515                      520                      525  
 Arg Lys Gly Glu Thr Asp Ile Gly Arg Lys Asn Thr Arg Val Arg Leu  
 530                      535                      540  
 Val Phe Arg Val His Ile Pro Glu Ser Ser Gly Arg Ile Val Ser Leu  
 545                      550                      555                      560  
 Gln Thr Ala Ser Asn Pro Ile Glu Cys Ser Gln Arg Ser Ala His Glu  
 565                      570                      575  
 Leu Pro Met Val Glu Arg Gln Asp Thr Asp Ser Cys Leu Val Tyr Gly  
 580                      585                      590  
 Gly Gln Gln Met Ile Leu Thr Gly Gln Asn Phe Thr Ser Glu Ser Lys  
 595                      600                      605  
 Val Val Phe Thr Glu Lys Thr Thr Asp Gly Gln Gln Ile Trp Glu Met  
 610                      615                      620  
 Glu Ala Thr Val Asp Lys Asp Lys Ser Gln Pro Asn Met Leu Phe Val  
 625                      630                      635                      640  
 Glu Ile Pro Glu Tyr Arg Asn Lys His Ile Arg Thr Pro Val Lys Val  
 645                      650                      655  
 Asn Phe Tyr Val Ile Asn Gly Lys Arg Lys Arg Ser Gln Pro Gln His

660	665	670
Phe Thr Tyr His Pro Val Pro Ala Ile Lys Thr Glu Pro Thr Asp Glu		
675	680	685
Tyr Asp Pro Thr Leu Ile Cys Ser Pro Thr His Gly Gly Leu Gly Ser		
690	695	700
Gln Pro Tyr Tyr Pro Gln His Pro Met Val Ala Glu Ser Pro Ser Cys		
705	710	715
Leu Val Ala Thr Met Ala Pro Cys Gln Gln Phe Arg Thr Gly Leu Ser		
725	730	735
Ser Pro Asp Ala Arg Tyr Gln Gln Gln Asn Pro Ala Ala Val Leu Tyr		
740	745	750
Gln Arg Ser Lys Ser Leu Ser Pro Ser Leu Leu Gly Tyr Gln Gln Pro		
755	760	765
Ala Leu Met Ala Ala Pro Leu Ser Leu Ala Asp Ala His Arg Ser Val		
770	775	780
Leu Val His Ala Gly Ser Gln Gly Gln Ser Ser Ala Leu Leu His Pro		
785	790	795
Ser Pro Thr Asn Gln Ala Ser Pro Val Ile His Tyr Ser Pro Thr		
805	810	815
Asn Gln Gln Leu Arg Cys Gly Ser His Gln Glu Phe Gln His Ile Met		
820	825	830
Tyr Cys Glu Asn Phe Ala Pro Gly Thr Thr Arg Pro Gly Pro Pro Pro		
835	840	845
Val Ser Gln Gly Gln Arg Leu Ser Pro Gly Ser Tyr Pro Thr Val Ile		
850	855	860
Gln Gln Gln Asn Ala Thr Ser Gln Arg Ala Ala Lys Asn Gly Pro Pro		
865	870	875
Val Ser Asp Gln Lys Glu Val Leu Pro Ala Gly Val Thr Ile Lys Gln		
885	890	895
Glu Gln Asn Leu Asp Gln Thr Tyr Leu Asp Asp Val Asn Glu Ile Ile		
900	905	910
Arg Lys Glu Phe Ser Gly Pro Pro Ala Arg Asn Gln Thr Arg Ile Leu		
915	920	925
Gln Ser Thr Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr Met Val		
930	935	940
Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu		
945	950	955
Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly		
965	970	975
Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr		
980	985	990
Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr		
995	1000	1005
Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His		
1010	1015	1020
Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr		
1025	1030	1035
Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys		
1045	1050	1055
Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp		
1060	1065	1070
Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr		
1075	1080	1085
Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile		
1090	1095	1100
Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln		
1105	1110	1115
Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val		

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          1125          1130          1135
Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys
          1140          1145          1150
Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr
          1155          1160          1165
Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys
          1170          1175          1180

```

## (2) INFORMATION FOR SEQ ID NO:134:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2802 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2799
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:134:

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ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG      48
Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu
  1              5              10              15

GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC      96
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly
          20              25              30

GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC     144
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile
          35              40              45

TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC     192
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr
          50              55              60

CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG     240
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys
          65              70              75              80

CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG     288
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu
          85              90              95

CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG     336
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu
          100             105             110

GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC     384
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly
          115             120             125

ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC     432

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Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	
130						135					140					
AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	GCC	GAC	AAG	CAG	AAG	AAC	480
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	
145					150				155					160		
GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	AAC	ATC	GAG	GAC	GGC	AGC	528
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	
				165				170						175		
GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	ACC	CCC	ATC	GGC	GAC	GGC	576
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	
			180				185						190			
CCC	GTG	CTG	CTG	CCC	GAC	AAC	CAC	TAC	CTG	AGC	ACC	CAG	TCC	GCC	CTG	624
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	
		195				200						205				
AGC	AAA	GAC	CCC	AAC	GAG	AAG	CGC	GAT	CAC	ATG	GTC	CTG	CTG	GAG	TTC	672
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	
210					215						220					
GTG	ACC	GCC	GCC	GGG	ATC	ACT	CTC	GGC	ATG	GAC	GAG	CTG	TAC	AAG	TCC	720
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	
225				230				235						240		
GGA	CTC	AGA	TCT	CGA	GGG	AGC	ATG	GGC	ACC	TTG	CGG	GAT	TTA	CAG	TAC	768
Gly	Leu	Arg	Ser	Arg	Gly	Ser	Met	Gly	Thr	Leu	Arg	Asp	Leu	Gln	Tyr	
				245				250						255		
GCG	CTC	CAG	GAG	AAG	ATC	GAG	GAG	CTG	AGG	CAG	CGG	GAT	GCT	CTC	ATC	816
Ala	Leu	Gln	Glu	Lys	Ile	Glu	Glu	Leu	Arg	Gln	Arg	Asp	Ala	Leu	Ile	
		260					265						270			
GAC	GAG	CTG	GAG	CTG	GAG	TTG	GAT	CAG	AAG	GAC	GAA	CTG	ATC	CAG	AAG	864
Asp	Glu	Leu	Glu	Leu	Glu	Leu	Asp	Gln	Lys	Asp	Glu	Leu	Ile	Gln	Lys	
		275				280					285					
CTG	CAG	AAC	GAG	CTG	GAC	AAG	TAC	CGC	TCG	GTG	ATC	CGA	CCA	GCC	ACC	912
Leu	Gln	Asn	Glu	Leu	Asp	Lys	Tyr	Arg	Ser	Val	Ile	Arg	Pro	Ala	Thr	
		290				295					300					
CAG	CAG	GCG	CAG	AAG	CAG	AGC	GCG	AGC	ACC	TTG	CAG	GGC	GAG	CCG	CGC	960
Gln	Gln	Ala	Gln	Lys	Gln	Ser	Ala	Ser	Thr	Leu	Gln	Gly	Glu	Pro	Arg	
305				310						315				320		
ACC	AAG	CGG	CAG	GCG	ATC	TCC	GCC	GAG	CCC	ACC	GCC	TTC	GAC	ATC	CAG	1008
Thr	Lys	Arg	Gln	Ala	Ile	Ser	Ala	Glu	Pro	Thr	Ala	Phe	Asp	Ile	Gln	
				325				330						335		
GAT	CTC	AGC	CAT	GTG	ACC	CTG	CCC	TTC	TAC	CCC	AAG	AGC	CCA	CAG	TCC	1056
Asp	Leu	Ser	His	Val	Thr	Leu	Pro	Phe	Tyr	Pro	Lys	Ser	Pro	Gln	Ser	
			340					345					350			
AAG	GAT	CTT	ATA	AAG	GAA	GCT	ATC	CTT	GAC	AAT	GAC	TTT	ATG	AAG	AAC	1104
Lys	Asp	Leu	Ile	Lys	Glu	Ala	Ile	Leu	Asp	Asn	Asp	Phe	Met	Lys	Asn	
		355				360						365				

TTG GAG CTG TCG CAG ATC CAG GAG ATT GTG GAT TGT ATG TAC CCG GTG	1152
Leu Glu Leu Ser Gln Ile Gln Glu Ile Val Asp Cys Met Tyr Pro Val	
370 375 380	
GAG TAT GGC AAG GAC AGT TGC ATC ATC AAA GAA GGA GAC GTG GGG TCA	1200
Glu Tyr Gly Lys Asp Ser Cys Ile Ile Lys Glu Gly Asp Val Gly Ser	
385 390 395 400	
CTG GTG TAT GTC ATG GAA GAT GGT AAG GTT GAA GTT ACA AAA GAA GGT	1248
Leu Val Tyr Val Met Glu Asp Gly Lys Val Glu Val Thr Lys Glu Gly	
405 410 415	
GTG AAG TTG TGT ACC ATG GGT CCA GGA AAA GTG TTT GGG GAA TTG GCT	1296
Val Lys Leu Cys Thr Met Gly Pro Gly Lys Val Phe Gly Glu Leu Ala	
420 425 430	
ATT CTT TAC AAC TGT ACC CGG ACA GCG ACC GTC AAG ACT CTT GTA AAT	1344
Ile Leu Tyr Asn Cys Thr Arg Thr Ala Thr Val Lys Thr Leu Val Asn	
435 440 445	
GTA AAA CTC TGG GCC ATT GAT CGA CAA TGT TTT CAA ACA ATA ATG ATG	1392
Val Lys Leu Trp Ala Ile Asp Arg Gln Cys Phe Gln Thr Ile Met Met	
450 455 460	
AGG ACA GGA CTC ATC AAG CAT ACC GAG TAT ATG GAA TTT TTA AAA AGC	1440
Arg Thr Gly Leu Ile Lys His Thr Glu Tyr Met Glu Phe Leu Lys Ser	
465 470 475 480	
GTT CCA ACA TTC CAG AGC CTT CCT GAA GAG ATC CTC AGC AAG CTT GCT	1488
Val Pro Thr Phe Gln Ser Leu Pro Glu Glu Ile Leu Ser Lys Leu Ala	
485 490 495	
GAT GTC CTT GAA GAG ACC CAC TAT GAA AAT GGA GAA TAT ATT ATC AGG	1536
Asp Val Leu Glu Glu Thr His Tyr Glu Asn Gly Glu Tyr Ile Ile Arg	
500 505 510	
CAA GGT GCA AGA GGG GAC ACC TTC TTT ATC ATC AGC AAA GGA ACG GTA	1584
Gln Gly Ala Arg Gly Asp Thr Phe Phe Ile Ile Ser Lys Gly Thr Val	
515 520 525	
AAT GTC ACT CGT GAA GAC TCA CCG AGT GAA GAC CCA GTC TTT CTT AGA	1632
Asn Val Thr Arg Glu Asp Ser Pro Ser Glu Asp Pro Val Phe Leu Arg	
530 535 540	
ACT TTA GGA AAA GGA GAC TGG TTT GGA GAG AAA GCC TTG CAG GGG GAA	1680
Thr Leu Gly Lys Gly Asp Trp Phe Gly Glu Lys Ala Leu Gln Gly Glu	
545 550 555 560	
GAT GTG AGA ACA GCA AAC GTA ATT GCT GCA GAA GCT GTA ACC TGC CTT	1728
Asp Val Arg Thr Ala Asn Val Ile Ala Ala Glu Ala Val Thr Cys Leu	
565 570 575	
GTG ATT GAC AGA GAC TCT TTT AAA CAT TTG ATT GGA GGG CTG GAT GAT	1776
Val Ile Asp Arg Asp Ser Phe Lys His Leu Ile Gly Gly Leu Asp Asp	
580 585 590	
GTT TCT AAT AAA GCA TAT GAA GAT GCA GAA GCT AAA GCA AAA TAT GAA	1824



Val	Ser	Asn	Lys	Ala	Tyr	Glu	Asp	Ala	Glu	Ala	Lys	Ala	Lys	Tyr	Glu	
		595					600					605				
GCT	GAA	GCG	GCT	TTC	TTC	GCC	AAC	CTG	AAG	CTG	TCT	GAT	TTC	AAC	ATC	1872
Ala	Glu	Ala	Ala	Phe	Phe	Ala	Asn	Leu	Lys	Leu	Ser	Asp	Phe	Asn	Ile	
	610					615				620						
ATT	GAT	ACC	CTT	GGA	GTT	GGA	GGT	TTC	GGA	CGA	GTA	GAA	CTG	GTC	CAG	1920
Ile	Asp	Thr	Leu	Gly	Val	Gly	Gly	Phe	Gly	Arg	Val	Glu	Leu	Val	Gln	
	625				630				635					640		
TTG	AAA	AGT	GAA	GAA	TCC	AAA	ACG	TTT	GCA	ATG	AAG	ATT	CTC	AAG	AAA	1968
Leu	Lys	Ser	Glu	Glu	Ser	Lys	Thr	Phe	Ala	Met	Lys	Ile	Leu	Lys	Lys	
			645						650				655			
CGT	CAC	ATT	GTG	GAC	ACA	AGA	CAG	CAG	GAG	CAC	ATC	CGC	TCA	GAG	AAG	2016
Arg	His	Ile	Val	Asp	Thr	Arg	Gln	Gln	Glu	His	Ile	Arg	Ser	Glu	Lys	
		660					665					670				
CAG	ATC	ATG	CAG	GGG	GCT	CAT	TCC	GAT	TTC	ATA	GTG	AGA	CTG	TAC	AGA	2064
Gln	Ile	Met	Gln	Gly	Ala	His	Ser	Asp	Phe	Ile	Val	Arg	Leu	Tyr	Arg	
	675						680				685					
ACA	TTT	AAG	GAC	AGC	AAA	TAT	TTG	TAT	ATG	TTG	ATG	GAA	GCT	TGT	CTA	2112
Thr	Phe	Lys	Asp	Ser	Lys	Tyr	Leu	Tyr	Met	Leu	Met	Glu	Ala	Cys	Leu	
	690					695				700						
GGT	GGA	GAG	CTC	TGG	ACC	ATT	CTC	AGG	GAT	AGA	GGT	TCG	TTT	GAA	GAT	2160
Gly	Gly	Glu	Leu	Trp	Thr	Ile	Leu	Arg	Asp	Arg	Gly	Ser	Phe	Glu	Asp	
	705				710				715					720		
TCT	ACA	ACC	AGA	TTT	TAC	ACA	GCA	TGT	GTG	GTA	GAA	GCT	TTT	GCC	TAT	2208
Ser	Thr	Thr	Arg	Phe	Tyr	Thr	Ala	Cys	Val	Val	Glu	Ala	Phe	Ala	Tyr	
			725					730					735			
CTG	CAT	TCC	AAA	GGA	ATC	ATT	TAC	AGG	GAC	CTC	AAG	CCA	GAA	AAT	CTC	2256
Leu	His	Ser	Lys	Gly	Ile	Ile	Tyr	Arg	Asp	Leu	Lys	Pro	Glu	Asn	Leu	
		740						745				750				
ATC	CTA	GAT	CAC	CGA	GGT	TAT	GCC	AAA	CTG	GTT	GAT	TTT	GGC	TTT	GCA	2304
Ile	Leu	Asp	His	Arg	Gly	Tyr	Ala	Lys	Leu	Val	Asp	Phe	Gly	Phe	Ala	
	755						760				765					
AAG	AAA	ATA	GGA	TTT	GGA	AAG	AAA	ACA	TGG	ACT	TTT	TGT	GGG	ACT	CCA	2352
Lys	Lys	Ile	Gly	Phe	Gly	Lys	Lys	Thr	Trp	Thr	Phe	Cys	Gly	Thr	Pro	
	770					775				780						
GAG	TAT	GTA	GCC	CCA	GAG	ATC	ATC	CTG	AAC	AAA	GGC	CAT	GAC	ATT	TCA	2400
Glu	Tyr	Val	Ala	Pro	Glu	Ile	Ile	Leu	Asn	Lys	Gly	His	Asp	Ile	Ser	
	785				790				795					800		
GCC	GAC	TAC	TGG	TCA	CTG	GGA	ATC	CTA	ATG	TAT	GAA	CTC	CTG	ACT	GGC	2448
Ala	Asp	Tyr	Trp	Ser	Leu	Gly	Ile	Leu	Met	Tyr	Glu	Leu	Leu	Thr	Gly	
			805					810					815			
AGC	CCA	CCT	TTC	TCA	GGC	CCA	GAT	CCT	ATG	AAA	ACC	TAT	AAC	ATC	ATA	2496
Ser	Pro	Pro	Phe	Ser	Gly	Pro	Asp	Pro	Met	Lys	Thr	Tyr	Asn	Ile	Ile	
		820						825					830			

TTG AGG GGG ATT GAC ATG ATA GAA TTT CCA AAG AAG ATT GCC AAA AAT	2544
Leu Arg Gly Ile Asp Met Ile Glu Phe Pro Lys Lys Ile Ala Lys Asn	
835 840 845	
GCT GCT AAT TTA ATT AAA AAA CTA TGC AGG GAC AAT CCA TCA GAA AGA	2592
Ala Ala Asn Leu Ile Lys Lys Leu Cys Arg Asp Asn Pro Ser Glu Arg	
850 855 860	
TTA GGG AAT TTG AAA AAT GGA GTA AAA GAC ATT CAA AAG CAC AAA TGG	2640
Leu Gly Asn Leu Lys Asn Gly Val Lys Asp Ile Gln Lys His Lys Trp	
865 870 875 880	
TTT GAG GGC TTT AAC TGG GAA GGC TTA AGA AAA GGT ACC TTG ACA CCT	2688
Phe Glu Gly Phe Asn Trp Glu Gly Leu Arg Lys Gly Thr Leu Thr Pro	
885 890 895	
CCT ATA ATA CCA AGT GTT GCA TCA CCC ACA GAC ACA AGT AAT TTT GAC	2736
Pro Ile Ile Pro Ser Val Ala Ser Pro Thr Asp Thr Ser Asn Phe Asp	
900 905 910	
AGT TTC CCT GAG GAC AAC GAT GAA CCA CCA CCT GAT GAC AAC TCA GGA	2784
Ser Phe Pro Glu Asp Asn Asp Glu Pro Pro Pro Asp Asp Asn Ser Gly	
915 920 925	
TGG GAT ATA GAC TTC TAA	2802
Trp Asp Ile Asp Phe	
930	

## (2) INFORMATION FOR SEQ ID NO:135:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 933 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:135:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu	
1 5 10 15	
Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly	
20 25 30	
Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile	
35 40 45	
Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr	
50 55 60	
Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys	
65 70 75 80	
Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu	
85 90 95	
Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu	
100 105 110	
Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly	

115	120	125
Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr		
130	135	140
Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn		
145	150	155
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser		160
165	170	175
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly		
180	185	190
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu		
195	200	205
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe		
210	215	220
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser		
225	230	235
Gly Leu Arg Ser Arg Gly Ser Met Gly Thr Leu Arg Asp Leu Gln Tyr		240
245	250	255
Ala Leu Gln Glu Lys Ile Glu Glu Leu Arg Gln Arg Asp Ala Leu Ile		
260	265	270
Asp Glu Leu Glu Leu Glu Leu Asp Gln Lys Asp Glu Leu Ile Gln Lys		
275	280	285
Leu Gln Asn Glu Leu Asp Lys Tyr Arg Ser Val Ile Arg Pro Ala Thr		
290	295	300
Gln Gln Ala Gln Lys Gln Ser Ala Ser Thr Leu Gln Gly Glu Pro Arg		
305	310	315
Thr Lys Arg Gln Ala Ile Ser Ala Glu Pro Thr Ala Phe Asp Ile Gln		320
325	330	335
Asp Leu Ser His Val Thr Leu Pro Phe Tyr Pro Lys Ser Pro Gln Ser		
340	345	350
Lys Asp Leu Ile Lys Glu Ala Ile Leu Asp Asn Asp Phe Met Lys Asn		
355	360	365
Leu Glu Leu Ser Gln Ile Gln Glu Ile Val Asp Cys Met Tyr Pro Val		
370	375	380
Glu Tyr Gly Lys Asp Ser Cys Ile Ile Lys Glu Gly Asp Val Gly Ser		
385	390	395
Leu Val Tyr Val Met Glu Asp Gly Lys Val Glu Val Thr Lys Glu Gly		400
405	410	415
Val Lys Leu Cys Thr Met Gly Pro Gly Lys Val Phe Gly Glu Leu Ala		
420	425	430
Ile Leu Tyr Asn Cys Thr Arg Thr Ala Thr Val Lys Thr Leu Val Asn		
435	440	445
Val Lys Leu Trp Ala Ile Asp Arg Gln Cys Phe Gln Thr Ile Met Met		
450	455	460
Arg Thr Gly Leu Ile Lys His Thr Glu Tyr Met Glu Phe Leu Lys Ser		
465	470	475
Val Pro Thr Phe Gln Ser Leu Pro Glu Glu Ile Leu Ser Lys Leu Ala		480
485	490	495
Asp Val Leu Glu Glu Thr His Tyr Glu Asn Gly Glu Tyr Ile Ile Arg		
500	505	510
Gln Gly Ala Arg Gly Asp Thr Phe Phe Ile Ile Ser Lys Gly Thr Val		
515	520	525
Asn Val Thr Arg Glu Asp Ser Pro Ser Glu Asp Pro Val Phe Leu Arg		
530	535	540
Thr Leu Gly Lys Gly Asp Trp Phe Gly Glu Lys Ala Leu Gln Gly Glu		
545	550	555
Asp Val Arg Thr Ala Asn Val Ile Ala Ala Glu Ala Val Thr Cys Leu		560
565	570	575
Val Ile Asp Arg Asp Ser Phe Lys His Leu Ile Gly Gly Leu Asp Asp		

Val	Ser	Asn	Lys	Ala	Tyr	Glu	Asp	Ala	Glu	Ala	Lys	Ala	Lys	Tyr	Glu
595							600						605		
Ala	Glu	Ala	Ala	Phe	Phe	Ala	Asn	Leu	Lys	Leu	Ser	Asp	Phe	Asn	Ile
610						615						620			
Ile	Asp	Thr	Leu	Gly	Val	Gly	Gly	Phe	Gly	Arg	Val	Glu	Leu	Val	Gln
625					630					635					640
Leu	Lys	Ser	Glu	Glu	Ser	Lys	Thr	Phe	Ala	Met	Lys	Ile	Leu	Lys	Lys
			645							650				655	
Arg	His	Ile	Val	Asp	Thr	Arg	Gln	Gln	Glu	His	Ile	Arg	Ser	Glu	Lys
			660						665				670		
Gln	Ile	Met	Gln	Gly	Ala	His	Ser	Asp	Phe	Ile	Val	Arg	Leu	Tyr	Arg
		675					680					685			
Thr	Phe	Lys	Asp	Ser	Lys	Tyr	Leu	Tyr	Met	Leu	Met	Glu	Ala	Cys	Leu
690						695						700			
Gly	Gly	Glu	Leu	Trp	Thr	Ile	Leu	Arg	Asp	Arg	Gly	Ser	Phe	Glu	Asp
705					710					715					720
Ser	Thr	Thr	Arg	Phe	Tyr	Thr	Ala	Cys	Val	Val	Glu	Ala	Phe	Ala	Tyr
			725						730					735	
Leu	His	Ser	Lys	Gly	Ile	Ile	Tyr	Arg	Asp	Leu	Lys	Pro	Glu	Asn	Leu
			740					745					750		
Ile	Leu	Asp	His	Arg	Gly	Tyr	Ala	Lys	Leu	Val	Asp	Phe	Gly	Phe	Ala
		755					760					765			
Lys	Lys	Ile	Gly	Phe	Gly	Lys	Lys	Thr	Trp	Thr	Phe	Cys	Gly	Thr	Pro
	770					775						780			
Glu	Tyr	Val	Ala	Pro	Glu	Ile	Ile	Leu	Asn	Lys	Gly	His	Asp	Ile	Ser
785					790					795					800
Ala	Asp	Tyr	Trp	Ser	Leu	Gly	Ile	Leu	Met	Tyr	Glu	Leu	Leu	Thr	Gly
			805						810					815	
Ser	Pro	Pro	Phe	Ser	Gly	Pro	Asp	Pro	Met	Lys	Thr	Tyr	Asn	Ile	Ile
			820						825				830		
Leu	Arg	Gly	Ile	Asp	Met	Ile	Glu	Phe	Pro	Lys	Lys	Ile	Ala	Lys	Asn
		835					840						845		
Ala	Ala	Asn	Leu	Ile	Lys	Lys	Leu	Cys	Arg	Asp	Asn	Pro	Ser	Glu	Arg
		850				855					860				
Leu	Gly	Asn	Leu	Lys	Asn	Gly	Val	Lys	Asp	Ile	Gln	Lys	His	Lys	Trp
865					870					875					880
Phe	Glu	Gly	Phe	Asn	Trp	Glu	Gly	Leu	Arg	Lys	Gly	Thr	Leu	Thr	Pro
			885						890					895	
Pro	Ile	Ile	Pro	Ser	Val	Ala	Ser	Pro	Thr	Asp	Thr	Ser	Asn	Phe	Asp
			900					905					910		
Ser	Phe	Pro	Glu	Asp	Asn	Asp	Glu	Pro	Pro	Pro	Asp	Asp	Asn	Ser	Gly
		915					920						925		
Trp	Asp	Ile	Asp	Phe											
930															

(2) INFORMATION FOR SEQ ID NO:136:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2799 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence

(B) LOCATION: 1...2795

(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:136:

ATG GGC ACC TTG CGG GAT TTA CAG TAC GCG CTC CAG GAG AAG ATC GAG	48
Met Gly Thr Leu Arg Asp Leu Gln Tyr Ala Leu Gln Glu Lys Ile Glu	
1 5 10 15	
GAG CTG AGG CAG CGG GAT GCT CTC ATC GAC GAG CTG GAG CTG GAG TTG	96
Glu Leu Arg Gln Arg Asp Ala Leu Ile Asp Glu Leu Glu Leu Glu Leu	
20 25 30	
GAT CAG AAG GAC GAA CTG ATC CAG AAG CTG CAG AAC GAG CTG GAC AAG	144
Asp Gln Lys Asp Glu Leu Ile Gln Lys Leu Gln Asn Glu Leu Asp Lys	
35 40 45	
TAC CGC TCG GTG ATC CGA CCA GCC ACC CAG CAG GCG CAG AAG CAG AGC	192
Tyr Arg Ser Val Ile Arg Pro Ala Thr Gln Gln Ala Gln Lys Gln Ser	
50 55 60	
GCG AGC ACC TTG CAG GGC GAG CCG CGC ACC AAG CGG CAG GCG ATC TCC	240
Ala Ser Thr Leu Gln Gly Glu Pro Arg Thr Lys Arg Gln Ala Ile Ser	
65 70 75 80	
GCC GAG CCC ACC GCC TTC GAC ATC CAG GAT CTC AGC CAT GTG ACC CTG	288
Ala Glu Pro Thr Ala Phe Asp Ile Gln Asp Leu Ser His Val Thr Leu	
85 90 95	
CCC TTC TAC CCC AAG AGC CCA CAG TCC AAG GAT CTT ATA AAG GAA GCT	336
Pro Phe Tyr Pro Lys Ser Pro Gln Ser Lys Asp Leu Ile Lys Glu Ala	
100 105 110	
ATC CTT GAC AAT GAC TTT ATG AAG AAC TTG GAG CTG TCG CAG ATC CAG	384
Ile Leu Asp Asn Asp Phe Met Lys Asn Leu Glu Leu Ser Gln Ile Gln	
115 120 125	
GAG ATT GTG GAT TGT ATG TAC CCG GTG GAG TAT GGC AAG GAC AGT TGC	432
Glu Ile Val Asp Cys Met Tyr Pro Val Glu Tyr Gly Lys Asp Ser Cys	
130 135 140	
ATC ATC AAA GAA GGA GAC GTG GGG TCA CTG GTG TAT GTC ATG GAA GAT	480
Ile Ile Lys Glu Gly Asp Val Gly Ser Leu Val Tyr Val Met Glu Asp	
145 150 155 160	
GGT AAG GTT GAA GTT ACA AAA GAA GGT GTG AAG TTG TGT ACC ATG GGT	528
Gly Lys Val Glu Val Thr Lys Glu Gly Val Lys Leu Cys Thr Met Gly	
165 170 175	
CCA GGA AAA GTG TTT GGG GAA TTG GCT ATT CTT TAC AAC TGT ACC CGG	576
Pro Gly Lys Val Phe Gly Glu Leu Ala Ile Leu Tyr Asn Cys Thr Arg	
180 185 190	
ACA GCG ACC GTC AAG ACT CTT GTA AAT GTA AAA CTC TGG GCC ATT GAT	624
Thr Ala Thr Val Lys Thr Leu Val Asn Val Lys Leu Trp Ala Ile Asp	
195 200 205	
CGA CAA TGT TTT CAA ACA ATA ATG ATG AGG ACA GGA CTC ATC AAG CAT	672

Arg Gln Cys Phe Gln Thr Ile Met Met Arg Thr Gly Leu Ile Lys His	
210 215 220	
ACC GAG TAT ATG GAA TTT TTA AAA AGC GTT CCA ACA TTC CAG AGC CTT	720
Thr Glu Tyr Met Glu Phe Leu Lys Ser Val Pro Thr Phe Gln Ser Leu	
225 230 235 240	
CCT GAA GAG ATC CTC AGC AAG CTT GCT GAT GTC CTT GAA GAG ACC CAC	768
Pro Glu Glu Ile Leu Ser Lys Leu Ala Asp Val Leu Glu Glu Thr His	
245 250 255	
TAT GAA AAT GGA GAA TAT ATT ATC AGG CAA GGT GCA AGA GGG GAC ACC	816
Tyr Glu Asn Gly Glu Tyr Ile Ile Arg Gln Gly Ala Arg Gly Asp Thr	
260 265 270	
TTC TTT ATC ATC AGC AAA GGA ACG GTA AAT GTC ACT CGT GAA GAC TCA	864
Phe Phe Ile Ile Ser Lys Gly Thr Val Asn Val Thr Arg Glu Asp Ser	
275 280 285	
CCG AGT GAA GAC CCA GTC TTT CTT AGA ACT TTA GGA AAA GGA GAC TGG	912
Pro Ser Glu Asp Pro Val Phe Leu Arg Thr Leu Gly Lys Gly Asp Trp	
290 295 300	
TTT GGA GAG AAA GCC TTG CAG GGG GAA GAT GTG AGA ACA GCA AAC GTA	960
Phe Gly Glu Lys Ala Leu Gln Gly Glu Asp Val Arg Thr Ala Asn Val	
305 310 315 320	
ATT GCT GCA GAA GCT GTA ACC TGC CTT GTG ATT GAC AGA GAC TCT TTT	1008
Ile Ala Ala Glu Ala Val Thr Cys Leu Val Ile Asp Arg Asp Ser Phe	
325 330 335	
AAA CAT TTG ATT GGA GGG CTG GAT GAT GTT TCT AAT AAA GCA TAT GAA	1056
Lys His Leu Ile Gly Gly Leu Asp Asp Val Ser Asn Lys Ala Tyr Glu	
340 345 350	
GAT GCA GAA GCT AAA GCA AAA TAT GAA GCT GAA GCG GCT TTC TTC GCC	1104
Asp Ala Glu Ala Lys Ala Lys Tyr Glu Ala Glu Ala Ala Phe Phe Ala	
355 360 365	
AAC CTG AAG CTG TCT GAT TTC AAC ATC ATT GAT ACC CTT GGA GTT GGA	1152
Asn Leu Lys Leu Ser Asp Phe Asn Ile Ile Asp Thr Leu Gly Val Gly	
370 375 380	
GGT TTC GGA CGA GTA GAA CTG GTC CAG TTG AAA AGT GAA GAA TCC AAA	1200
Gly Phe Gly Arg Val Glu Leu Val Gln Leu Lys Ser Glu Glu Ser Lys	
385 390 395 400	
ACG TTT GCA ATG AAG ATT CTC AAG AAA CGT CAC ATT GTG GAC ACA AGA	1248
Thr Phe Ala Met Lys Ile Leu Lys Lys Arg His Ile Val Asp Thr Arg	
405 410 415	
CAG CAG GAG CAC ATC CGC TCA GAG AAG CAG ATC ATG CAG GGG GCT CAT	1296
Gln Gln Glu His Ile Arg Ser Glu Lys Gln Ile Met Gln Gly Ala His	
420 425 430	
TCC GAT TTC ATA GTG AGA CTG TAC AGA ACA TTT AAG GAC AGC AAA TAT	1344
Ser Asp Phe Ile Val Arg Leu Tyr Arg Thr Phe Lys Asp Ser Lys Tyr	
435 440 445	

TTG TAT ATG TTG ATG GAA GCT TGT CTA GGT GGA GAG CTC TGG ACC ATT	1392
Leu Tyr Met Leu Met Glu Ala Cys Leu Gly Gly Glu Leu Trp Thr Ile	
450 455 460	
CTC AGG GAT AGA GGT TCG TTT GAA GAT TCT ACA ACC AGA TTT TAC ACA	1440
Leu Arg Asp Arg Gly Ser Phe Glu Asp Ser Thr Thr Arg Phe Tyr Thr	
465 470 475 480	
GCA TGT GTG GTA GAA GCT TTT GCC TAT CTG CAT TCC AAA GGA ATC ATT	1488
Ala Cys Val Val Glu Ala Phe Ala Tyr Leu His Ser Lys Gly Ile Ile	
485 490 495	
TAC AGG GAC CTC AAG CCA GAA AAT CTC ATC CTA GAT CAC CGA GGT TAT	1536
Tyr Arg Asp Leu Lys Pro Glu Asn Leu Ile Leu Asp His Arg Gly Tyr	
500 505 510	
GCC AAA CTG GTT GAT TTT GGC TTT GCA AAG AAA ATA GGA TTT GGA AAG	1584
Ala Lys Leu Val Asp Phe Gly Phe Ala Lys Lys Ile Gly Phe Gly Lys	
515 520 525	
AAA ACA TGG ACT TTT TGT GGG ACT CCA GAG TAT GTA GCC CCA GAG ATC	1632
Lys Thr Trp Thr Phe Cys Gly Thr Pro Glu Tyr Val Ala Pro Glu Ile	
530 535 540	
ATC CTG AAC AAA GGC CAT GAC ATT TCA GCC GAC TAC TGG TCA CTG GGA	1680
Ile Leu Asn Lys Gly His Asp Ile Ser Ala Asp Tyr Trp Ser Leu Gly	
545 550 555 560	
ATC CTA ATG TAT GAA CTC CTG ACT GGC AGC CCA CCT TTC TCA GGC CCA	1728
Ile Leu Met Tyr Glu Leu Leu Thr Gly Ser Pro Pro Phe Ser Gly Pro	
565 570 575	
GAT CCT ATG AAA ACC TAT AAC ATC ATA TTG AGG GGG ATT GAC ATG ATA	1776
Asp Pro Met Lys Thr Tyr Asn Ile Ile Leu Arg Gly Ile Asp Met Ile	
580 585 590	
GAA TTT CCA AAG AAG ATT GCC AAA AAT GCT GCT AAT TTA ATT AAA AAA	1824
Glu Phe Pro Lys Lys Ile Ala Lys Asn Ala Ala Asn Leu Ile Lys Lys	
595 600 605	
CTA TGC AGG GAC AAT CCA TCA GAA AGA TTA GGG AAT TTG AAA AAT GGA	1872
Leu Cys Arg Asp Asn Pro Ser Glu Arg Leu Gly Asn Leu Lys Asn Gly	
610 615 620	
GTA AAA GAC ATT CAA AAG CAC AAA TGG TTT GAG GGC TTT AAC TGG GAA	1920
Val Lys Asp Ile Gln Lys His Lys Trp Phe Glu Gly Phe Asn Trp Glu	
625 630 635 640	
GGC TTA AGA AAA GGT ACC TTG ACA CCT CCT ATA ATA CCA AGT GTT GCA	1968
Gly Leu Arg Lys Gly Thr Leu Thr Pro Pro Ile Ile Pro Ser Val Ala	
645 650 655	
TCA CCC ACA GAC ACA AGT AAT TTT GAC AGT TTC CCT GAG GAC AAC GAT	2016
Ser Pro Thr Asp Thr Ser Asn Phe Asp Ser Phe Pro Glu Asp Asn Asp	
660 665 670	
GAA CCA CCA CCT GAT GAC AAC TCA GGA TGG GAT ATA GAC TTC TCG GAT	2064

Glu	Pro	Pro	Pro	Asp	Asp	Asn	Ser	Gly	Trp	Asp	Ile	Asp	Phe	Ser	Asp		
		675					680					685					
CCA	CCG	GTC	GCC	ACC	ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	2112	
Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly		
		690					695					700					
GTG	GTG	CCC	ATC	CTG	GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	2160	
Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys		
705					710					715					720		
TTC	AGC	GTG	TCC	GGC	GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	2208	
Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu		
				725					730					735			
ACC	CTG	AAG	TTC	ATC	TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	2256	
Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro		
			740					745					750				
ACC	CTC	GTG	ACC	ACC	CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	2304	
Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr		
		755					760						765				
CCC	GAC	CAC	ATG	AAG	CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	2352	
Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu		
	770					775						780					
GGC	TAC	GTC	CAG	GAG	CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	2400	
Gly	Tyr	Val	Gln	Glu	Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr		
785					790					795					800		
AAG	ACC	CGC	GCC	GAG	GTG	AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	CGC	2448	
Lys	Thr	Arg	Ala	Glu	Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg		
			805						810					815			
ATC	GAG	CTG	AAG	GGC	ATC	GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	CTG	GGG	2496	
Ile	Glu	Leu	Lys	Gly	Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly		
			820					825					830				
CAC	AAG	CTG	GAG	TAC	AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	GCC	2544	
His	Lys	Leu	Glu	Tyr	Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala		
		835					840					845					
GAC	AAG	CAG	AAG	AAC	GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	AAC	2592	
Asp	Lys	Gln	Lys	Asn	Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn		
	850					855					860						
ATC	GAG	GAC	GGC	AGC	GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	ACC	2640	
Ile	Glu	Asp	Gly	Ser	Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr		
865					870					875				880			
CCC	ATC	GGC	GAC	GGC	CCC	GTG	CTG	CTG	CCC	GAC	AAC	CAC	TAC	CTG	AGC	2688	
Pro	Ile	Gly	Asp	Gly	Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser		
				885					890					895			
ACC	CAG	TCC	GCC	CTG	AGC	AAA	GAC	CCC	AAC	GAG	AAG	CGC	GAT	CAC	ATG	2736	
Thr	Gln	Ser	Ala	Leu	Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met		
			900					905					910				



[illegible]

(2) INFORMATION FOR SEQ ID NO:137:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 932 amino acids  
(B) TYPE: amino acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:137:

Met	Gly	Thr	Leu	Arg	Asp	Leu	Gln	Tyr	Ala	Leu	Gln	Glu	Lys	Ile	Glu
1				5					10					15	
Glu	Leu	Arg	Gln	Arg	Asp	Ala	Leu	Ile	Asp	Glu	Leu	Glu	Leu	Glu	Leu
			20					25					30		
Asp	Gln	Lys	Asp	Glu	Leu	Ile	Gln	Lys	Leu	Gln	Asn	Glu	Leu	Asp	Lys
		35					40					45			
Tyr	Arg	Ser	Val	Ile	Arg	Pro	Ala	Thr	Gln	Gln	Ala	Gln	Lys	Gln	Ser
	50					55					60				
Ala	Ser	Thr	Leu	Gln	Gly	Glu	Pro	Arg	Thr	Lys	Arg	Gln	Ala	Ile	Ser
65					70					75					80
Ala	Glu	Pro	Thr	Ala	Phe	Asp	Ile	Gln	Asp	Leu	Ser	His	Val	Thr	Leu
				85					90					95	
Pro	Phe	Tyr	Pro	Lys	Ser	Pro	Gln	Ser	Lys	Asp	Leu	Ile	Lys	Glu	Ala
			100					105					110		
Ile	Leu	Asp	Asn	Asp	Phe	Met	Lys	Asn	Leu	Glu	Leu	Ser	Gln	Ile	Gln
		115					120					125			
Glu	Ile	Val	Asp	Cys	Met	Tyr	Pro	Val	Glu	Tyr	Gly	Lys	Asp	Ser	Cys
	130					135					140				
Ile	Ile	Lys	Glu	Gly	Asp	Val	Gly	Ser	Leu	Val	Tyr	Val	Met	Glu	Asp
145					150					155					160
Gly	Lys	Val	Glu	Val	Thr	Lys	Glu	Gly	Val	Lys	Leu	Cys	Thr	Met	Gly
				165					170					175	
Pro	Gly	Lys	Val	Phe	Gly	Glu	Leu	Ala	Ile	Leu	Tyr	Asn	Cys	Thr	Arg
			180					185					190		
Thr	Ala	Thr	Val	Lys	Thr	Leu	Val	Asn	Val	Lys	Leu	Trp	Ala	Ile	Asp
		195					200					205			
Arg	Gln	Cys	Phe	Gln	Thr	Ile	Met	Met	Arg	Thr	Gly	Leu	Ile	Lys	His
	210					215					220				
Thr	Glu	Tyr	Met	Glu	Phe	Leu	Lys	Ser	Val	Pro	Thr	Phe	Gln	Ser	Leu
225					230					235					240
Pro	Glu	Glu	Ile	Leu	Ser	Lys	Leu	Ala	Asp	Val	Leu	Glu	Glu	Thr	His
			245						250					255	
Tyr	Glu	Asn	Gly	Glu	Tyr	Ile	Ile	Arg	Gln	Gly	Ala	Arg	Gly	Asp	Thr
		260						265					270		
Phe	Phe	Ile	Ile	Ser	Lys	Gly	Thr	Val	Asn	Val	Thr	Arg	Glu	Asp	Ser

275	280	285
Pro Ser Glu Asp	Pro Val Phe Leu Arg Thr Leu Gly Lys Gly Asp Trp	
290	295	300
Phe Gly Glu Lys Ala Leu Gln Gly Glu Asp Val Arg Thr Ala Asn Val		
305	310	315
Ile Ala Ala Glu Ala Val Thr Cys Leu Val Ile Asp Arg Asp Ser Phe		320
325	330	335
Lys His Leu Ile Gly Gly Leu Asp Asp Val Ser Asn Lys Ala Tyr Glu		
340	345	350
Asp Ala Glu Ala Lys Ala Lys Tyr Glu Ala Glu Ala Ala Phe Phe Ala		
355	360	365
Asn Leu Lys Leu Ser Asp Phe Asn Ile Ile Asp Thr Leu Gly Val Gly		
370	375	380
Gly Phe Gly Arg Val Glu Leu Val Gln Leu Lys Ser Glu Glu Ser Lys		
385	390	395
Thr Phe Ala Met Lys Ile Leu Lys Lys Arg His Ile Val Asp Thr Arg		400
405	410	415
Gln Gln Glu His Ile Arg Ser Glu Lys Gln Ile Met Gln Gly Ala His		
420	425	430
Ser Asp Phe Ile Val Arg Leu Tyr Arg Thr Phe Lys Asp Ser Lys Tyr		
435	440	445
Leu Tyr Met Leu Met Glu Ala Cys Leu Gly Gly Glu Leu Trp Thr Ile		
450	455	460
Leu Arg Asp Arg Gly Ser Phe Glu Asp Ser Thr Thr Arg Phe Tyr Thr		
465	470	475
Ala Cys Val Val Glu Ala Phe Ala Tyr Leu His Ser Lys Gly Ile Ile		480
485	490	495
Tyr Arg Asp Leu Lys Pro Glu Asn Leu Ile Leu Asp His Arg Gly Tyr		
500	505	510
Ala Lys Leu Val Asp Phe Gly Phe Ala Lys Lys Ile Gly Phe Gly Lys		
515	520	525
Lys Thr Trp Thr Phe Cys Gly Thr Pro Glu Tyr Val Ala Pro Glu Ile		
530	535	540
Ile Leu Asn Lys Gly His Asp Ile Ser Ala Asp Tyr Trp Ser Leu Gly		
545	550	555
Ile Leu Met Tyr Glu Leu Leu Thr Gly Ser Pro Pro Phe Ser Gly Pro		
565	570	575
Asp Pro Met Lys Thr Tyr Asn Ile Ile Leu Arg Gly Ile Asp Met Ile		
580	585	590
Glu Phe Pro Lys Lys Ile Ala Lys Asn Ala Ala Asn Leu Ile Lys Lys		
595	600	605
Leu Cys Arg Asp Asn Pro Ser Glu Arg Leu Gly Asn Leu Lys Asn Gly		
610	615	620
Val Lys Asp Ile Gln Lys His Lys Trp Phe Glu Gly Phe Asn Trp Glu		
625	630	635
Gly Leu Arg Lys Gly Thr Leu Thr Pro Pro Ile Ile Pro Ser Val Ala		
645	650	655
Ser Pro Thr Asp Thr Ser Asn Phe Asp Ser Phe Pro Glu Asp Asn Asp		
660	665	670
Glu Pro Pro Pro Asp Asp Asn Ser Gly Trp Asp Ile Asp Phe Ser Asp		
675	680	685
Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly		
690	695	700
Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His Lys		
705	710	715
Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu		
725	730	735
Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro		

[illegible]

(2) INFORMATION FOR SEQ ID NO:138:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2184 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...2181  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:138:

ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	48
Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	
1				5					10					15		
GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	96
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	
			20					25					30			
GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	144
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	
		35					40					45				
TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	192
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	
	50					55					60					

CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys 65 70 75 80	240
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu 85 90 95	288
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu 100 105 110	336
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 115 120 125	384
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 130 135 140	432
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn 145 150 155 160	480
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser 165 170 175	528
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly 180 185 190	576
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu 195 200 205	624
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe 210 215 220	672
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TCC Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser 225 230 235 240	720
GGA CTC AGA TCT CGA GGC ACC ATG AGC GAC GTG GCT ATT GTG AAG GAG Gly Leu Arg Ser Arg Gly Thr Met Ser Asp Val Ala Ile Val Lys Glu 245 250 255	768
GGT TGG CTG CAC AAA CGA GGG GAG TAC ATC AAG ACC TGG CGG CCA CGC Gly Trp Leu His Lys Arg Gly Glu Tyr Ile Lys Thr Trp Arg Pro Arg 260 265 270	816
TAC TTC CTC CTC AAG AAT GAT GGC ACC TTC ATT GGC TAC AAG GAG CGG Tyr Phe Leu Leu Lys Asn Asp Gly Thr Phe Ile Gly Tyr Lys Glu Arg 275 280 285	864
CCG CAG GAT GTG GAC CAA CGT GAG GCT CCC CTC AAC AAC TTC TCT GTG	912

Pro Gln Asp Val Asp Gln Arg Glu Ala Pro Leu Asn Asn Phe Ser Val	
290 295 300	
GCG CAG TGC CAG CTG ATG AAG ACG GAG CGG CCC CGG CCC AAC ACC TTC	960
Ala Gln Cys Gln Leu Met Lys Thr Glu Arg Pro Arg Pro Asn Thr Phe	
305 310 315 320	
ATC ATC CGC TGC CTG CAG TGG ACC ACT GTC ATC GAA CGC ACC TTC CAT	1008
Ile Ile Arg Cys Leu Gln Trp Thr Thr Val Ile Glu Arg Thr Phe His	
325 330 335	
GTG GAG ACT CCT GAG GAG CGG GAG GAG TGG ACA ACC GCC ATC CAG ACT	1056
Val Glu Thr Pro Glu Glu Arg Glu Glu Trp Thr Thr Ala Ile Gln Thr	
340 345 350	
GTG GCT GAC GGC CTC AAG AAG CAG GAG GAG GAG GAG ATG GAC TTC CGG	1104
Val Ala Asp Gly Leu Lys Lys Gln Glu Glu Glu Glu Met Asp Phe Arg	
355 360 365	
TCG GGC TCA CCC AGT GAC AAC TCA GGG GCT GAA GAG ATG GAG GTG TCC	1152
Ser Gly Ser Pro Ser Asp Asn Ser Gly Ala Glu Glu Met Glu Val Ser	
370 375 380	
CTG GCC AAG CCC AAG CAC CGC GTG ACC ATG AAC GAG TTT GAG TAC CTG	1200
Leu Ala Lys Pro Lys His Arg Val Thr Met Asn Glu Phe Glu Tyr Leu	
385 390 395 400	
AAG CTG CTG GGC AAG GGC ACT TTC GGC AAG GTG ATC CTG GTG AAG GAG	1248
Lys Leu Leu Gly Lys Gly Thr Phe Gly Lys Val Ile Leu Val Lys Glu	
405 410 415	
AAG GCC ACA GGC CGC TAC TAC GCC ATG AAG ATC CTC AAG AAG GAA GTC	1296
Lys Ala Thr Gly Arg Tyr Tyr Ala Met Lys Ile Leu Lys Lys Glu Val	
420 425 430	
ATC GTG GCC AAG GAC GAG GTG GCC CAC ACA CTC ACC GAG AAC CGC GTC	1344
Ile Val Ala Lys Asp Glu Val Ala His Thr Leu Thr Glu Asn Arg Val	
435 440 445	
CTG CAG AAC TCC AGG CAC CCC TTC CTC ACA GCC CTG AAG TAC TCT TTC	1392
Leu Gln Asn Ser Arg His Pro Phe Leu Thr Ala Leu Lys Tyr Ser Phe	
450 455 460	
CAG ACC CAC GAC CGC CTC TGC TTT GTC ATG GAG TAC GCC AAC GGG GGC	1440
Gln Thr His Asp Arg Leu Cys Phe Val Met Glu Tyr Ala Asn Gly Gly	
465 470 475 480	
GAG CTG TTC TTC CAC CTG TCC CGG GAA CGT GTG TTC TCC GAG GAC CGG	1488
Glu Leu Phe Phe His Leu Ser Arg Glu Arg Val Phe Ser Glu Asp Arg	
485 490 495	
GCC CGC TTC TAT GGC GCT GAG ATT GTG TCA GCC CTG GAC TAC CTG CAC	1536
Ala Arg Phe Tyr Gly Ala Glu Ile Val Ser Ala Leu Asp Tyr Leu His	
500 505 510	
TCG GAG AAG AAC GTG GTG TAC CGG GAC CTC AAG CTG GAG AAC CTC ATG	1584
Ser Glu Lys Asn Val Val Tyr Arg Asp Leu Lys Leu Glu Asn Leu Met	
515 520 525	

CTG GAC AAG GAC GGG CAC ATT AAG ATC ACA GAC TTC GGG CTG TGC AAG Leu Asp Lys Asp Gly His Ile Lys Ile Thr Asp Phe Gly Leu Cys Lys 530 535 540	1632
GAG GGG ATC AAG GAC GGT GCC ACC ATG AAG ACC TTT TGC GGC ACA CCT Glu Gly Ile Lys Asp Gly Ala Thr Met Lys Thr Phe Cys Gly Thr Pro 545 550 555 560	1680
GAG TAC CTG GCC CCC GAG GTG CTG GAG GAC AAT GAC TAC GGC CGT GCA Glu Tyr Leu Ala Pro Glu Val Leu Glu Asp Asn Asp Tyr Gly Arg Ala 565 570 575	1728
GTG GAC TGG TGG GGG CTG GGC GTG GTC ATG TAC GAG ATG ATG TGC GGT Val Asp Trp Trp Gly Leu Gly Val Val Met Tyr Glu Met Met Cys Gly 580 585 590	1776
CGC CTG CCC TTC TAC AAC CAG GAC CAT GAG AAG CTT TTT GAG CTC ATC Arg Leu Pro Phe Tyr Asn Gln Asp His Glu Lys Leu Phe Glu Leu Ile 595 600 605	1824
CTC ATG GAG GAG ATC CGC TTC CCG CGC ACG CTT GGT CCC GAG GCC AAG Leu Met Glu Glu Ile Arg Phe Pro Arg Thr Leu Gly Pro Glu Ala Lys 610 615 620	1872
TCC TTG CTT TCA GGG CTG CTC AAG AAG GAC CCC AAG CAG AGG CTT GGC Ser Leu Leu Ser Gly Leu Leu Lys Lys Asp Pro Lys Gln Arg Leu Gly 625 630 635 640	1920
GGG GGC TCC GAG GAC GCC AAG GAG ATC ATG CAG CAT CGC TTC TTT GCC Gly Gly Ser Glu Asp Ala Lys Glu Ile Met Gln His Arg Phe Phe Ala 645 650 655	1968
GGT ATC GTG TGG CAG CAC GTG TAC GAG AAG AAG CTC AGC CCA CCC TTC Gly Ile Val Trp Gln His Val Tyr Glu Lys Lys Leu Ser Pro Pro Phe 660 665 670	2016
AAG CCC CAG GTC ACG TCG GAG ACT GAC ACC AGG TAT TTT GAT GAG GAG Lys Pro Gln Val Thr Ser Glu Thr Asp Thr Arg Tyr Phe Asp Glu Glu 675 680 685	2064
TTC ACG GCC CAG ATG ATC ACC ATC ACA CCA CCT GAC CAA GAT GAC AGC Phe Thr Ala Gln Met Ile Thr Ile Thr Pro Pro Asp Gln Asp Asp Ser 690 695 700	2112
ATG GAG TGT GTG GAC AGC GAG CGC AGG CCC CAC TTC CCC CAG TTC TCC Met Glu Cys Val Asp Ser Glu Arg Arg Pro His Phe Pro Gln Phe Ser 705 710 715 720	2160
TAC TCG GCC AGC AGC ACG GCC TGA Tyr Ser Ala Ser Ser Thr Ala 725	2184

## (2) INFORMATION FOR SEQ ID NO:139:

## (i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 727 amino acids

(B) TYPE: amino acid  
 (C) STRANDEDNESS: single  
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein  
 (v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:139:

Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu
1				5					10					15	
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly
			20					25					30		
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile
			35				40					45			
Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr
	50					55					60				
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys
65					70					75					80
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu
				85					90					95	
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu
			100					105						110	
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly
			115				120					125			
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr
	130					135					140				
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn
145					150					155					160
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser
				165					170					175	
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly
			180					185					190		
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu
			195				200					205			
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe
	210					215					220				
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser
225					230					235					240
Gly	Leu	Arg	Ser	Arg	Gly	Thr	Met	Ser	Asp	Val	Ala	Ile	Val	Lys	Glu
				245					250					255	
Gly	Trp	Leu	His	Lys	Arg	Gly	Glu	Tyr	Ile	Lys	Thr	Trp	Arg	Pro	Arg
			260				265						270		
Tyr	Phe	Leu	Leu	Lys	Asn	Asp	Gly	Thr	Phe	Ile	Gly	Tyr	Lys	Glu	Arg
			275				280					285			
Pro	Gln	Asp	Val	Asp	Gln	Arg	Glu	Ala	Pro	Leu	Asn	Asn	Phe	Ser	Val
			290			295					300				
Ala	Gln	Cys	Gln	Leu	Met	Lys	Thr	Glu	Arg	Pro	Arg	Pro	Asn	Thr	Phe
305					310					315					320
Ile	Ile	Arg	Cys	Leu	Gln	Trp	Thr	Thr	Val	Ile	Glu	Arg	Thr	Phe	His
			325						330				335		
Val	Glu	Thr	Pro	Glu	Glu	Arg	Glu	Glu	Trp	Thr	Thr	Ala	Ile	Gln	Thr
			340				345						350		
Val	Ala	Asp	Gly	Leu	Lys	Lys	Gln	Glu	Glu	Glu	Glu	Met	Asp	Phe	Arg
			355				360					365			
Ser	Gly	Ser	Pro	Ser	Asp	Asn	Ser	Gly	Ala	Glu	Glu	Met	Glu	Val	Ser
	370					375					380				
Leu	Ala	Lys	Pro	Lys	His	Arg	Val	Thr	Met	Asn	Glu	Phe	Glu	Tyr	Leu

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385          390          395          400
Lys Leu Leu Gly Lys Gly Thr Phe Gly Lys Val Ile Leu Val Lys Glu
          405          410          415
Lys Ala Thr Gly Arg Tyr Tyr Ala Met Lys Ile Leu Lys Lys Glu Val
          420          425          430
Ile Val Ala Lys Asp Glu Val Ala His Thr Leu Thr Glu Asn Arg Val
          435          440          445
Leu Gln Asn Ser Arg His Pro Phe Leu Thr Ala Leu Lys Tyr Ser Phe
          450          455          460
Gln Thr His Asp Arg Leu Cys Phe Val Met Glu Tyr Ala Asn Gly Gly
          465          470          475          480
Glu Leu Phe Phe His Leu Ser Arg Glu Arg Val Phe Ser Glu Asp Arg
          485          490          495
Ala Arg Phe Tyr Gly Ala Glu Ile Val Ser Ala Leu Asp Tyr Leu His
          500          505          510
Ser Glu Lys Asn Val Val Tyr Arg Asp Leu Lys Leu Glu Asn Leu Met
          515          520          525
Leu Asp Lys Asp Gly His Ile Lys Ile Thr Asp Phe Gly Leu Cys Lys
          530          535          540
Glu Gly Ile Lys Asp Gly Ala Thr Met Lys Thr Phe Cys Gly Thr Pro
          545          550          555          560
Glu Tyr Leu Ala Pro Glu Val Leu Glu Asp Asn Asp Tyr Gly Arg Ala
          565          570          575
Val Asp Trp Trp Gly Leu Gly Val Val Met Tyr Glu Met Met Cys Gly
          580          585          590
Arg Leu Pro Phe Tyr Asn Gln Asp His Glu Lys Leu Phe Glu Leu Ile
          595          600          605
Leu Met Glu Glu Ile Arg Phe Pro Arg Thr Leu Gly Pro Glu Ala Lys
          610          615          620
Ser Leu Leu Ser Gly Leu Leu Lys Lys Asp Pro Lys Lys Arg Leu Gly
          625          630          635          640
Gly Gly Ser Glu Asp Ala Lys Glu Ile Met Gln His Arg Phe Phe Ala
          645          650          655
Gly Ile Val Trp Gln His Val Tyr Glu Lys Lys Leu Ser Pro Pro Phe
          660          665          670
Lys Pro Gln Val Thr Ser Glu Thr Asp Thr Arg Tyr Phe Asp Glu Glu
          675          680          685
Phe Thr Ala Gln Met Ile Thr Ile Thr Pro Pro Asp Gln Asp Asp Ser
          690          695          700
Met Glu Cys Val Asp Ser Glu Arg Arg Pro His Phe Pro Gln Phe Ser
          705          710          715          720
Tyr Ser Ala Ser Ser Thr Ala
          725

```

## (2) INFORMATION FOR SEQ ID NO:140:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2394 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2391
- (D) OTHER INFORMATION:



## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:140:

ATG GAC GAA CTG TTC CCC CTC ATC TTC CCG GCA GAG CCA GCC CAG GCC	48
Met Asp Glu Leu Phe Pro Leu Ile Phe Pro Ala Glu Pro Ala Gln Ala	
1 5 10 15	
TCT GGC CCC TAT GTG GAG ATC ATT GAG CAG CCC AAG CAG CGG GGC ATG	96
Ser Gly Pro Tyr Val Glu Ile Ile Glu Gln Pro Lys Gln Arg Gly Met	
20 25 30	
CGC TTC CGC TAC AAG TGC GAG GGG CGC TCC GCG GGC AGC ATC CCA GGC	144
Arg Phe Arg Tyr Lys Cys Glu Gly Arg Ser Ala Gly Ser Ile Pro Gly	
35 40 45	
GAG AGG AGC ACA GAT ACC ACC AAG ACC CAC CCC ACC ATC AAG ATC AAT	192
Glu Arg Ser Thr Asp Thr Lys Thr His Pro Thr Ile Lys Ile Asn	
50 55 60	
GGC TAC ACA GGA CCA GGG ACA GTG CGC ATC TCC CTG GTC ACC AAG GAC	240
Gly Tyr Thr Gly Pro Gly Thr Val Arg Ile Ser Leu Val Thr Lys Asp	
65 70 75 80	
CCT CCT CAC CGG CCT CAC CCC CAC GAG CTT GTA GGA AAG GAC TGC CGG	288
Pro Pro His Arg Pro His Pro His Glu Leu Val Gly Lys Asp Cys Arg	
85 90 95	
GAT GGC TTC TAT GAG GCT GAG CTC TGC CCG GAC CGC TGC ATC CAC AGT	336
Asp Gly Phe Tyr Glu Ala Glu Leu Cys Pro Asp Arg Cys Ile His Ser	
100 105 110	
TTC CAG AAC CTG GGA ATC CAG TGT GTG AAG AAG CGG GAC CTG GAG CAG	384
Phe Gln Asn Leu Gly Ile Gln Cys Val Lys Lys Arg Asp Leu Glu Gln	
115 120 125	
GCT ATC AGT CAG CGC ATC CAG ACC AAC AAC AAC CCC TTC CAA GTT CCT	432
Ala Ile Ser Gln Arg Ile Gln Thr Asn Asn Asn Pro Phe Gln Val Pro	
130 135 140	
ATA GAA GAG CAG CGT GGG GAC TAC GAC CTG AAT GCT GTG CGG CTC TGC	480
Ile Glu Glu Gln Arg Gly Asp Tyr Asp Leu Asn Ala Val Arg Leu Cys	
145 150 155 160	
TTC CAG GTG ACA GTG CGG GAC CCA TCA GGC AGG CCC CTC CGC CTG CCG	528
Phe Gln Val Thr Val Arg Asp Pro Ser Gly Arg Pro Leu Arg Leu Pro	
165 170 175	
CCT GTC CTT CCT CAT CCC ATC TTT GAC AAT CGT GCC CCC AAC ACT GCC	576
Pro Val Leu Pro His Pro Ile Phe Asp Asn Arg Ala Pro Asn Thr Ala	
180 185 190	
GAG CTC AAG ATC TGC CGA GTG AAC CGA AAC TCT GGC AGC TGC CTC GGT	624
Glu Leu Lys Ile Cys Arg Val Asn Arg Asn Ser Gly Ser Cys Leu Gly	
195 200 205	
GGG GAT GAG ATC TTC CTA CTG TGT GAC AAG GTG CAG AAA GAG GAC ATT	672
Gly Asp Glu Ile Phe Leu Leu Cys Asp Lys Val Gln Lys Glu Asp Ile	
210 215 220	

GAG GTG TAT TTC ACG GGA CCA GGC TGG GAG GCC CGA GGC TCC TTT TCG	720
Glu Val Tyr Phe Thr Gly Pro Gly Trp Glu Ala Arg Gly Ser Phe Ser	
225 230 235 240	
CAA GCT GAT GTG CAC CGA CAA GTG GCC ATT GTG TTC CGG ACC CCT CCC	768
Gln Ala Asp Val His Arg Gln Val Ala Ile Val Phe Arg Thr Pro Pro	
245 250 255	
TAC GCA GAC CCC AGC CTG CAG GCT CCT GTG CGT GTC TCC ATG CAG CTG	816
Tyr Ala Asp Pro Ser Leu Gln Ala Pro Val Arg Val Ser Met Gln Leu	
260 265 270	
CGG CGG CCT TCC GAC CGG GAG CTC AGT GAG CCC ATG GAA TTC CAG TAC	864
Arg Arg Pro Ser Asp Arg Glu Ser Glu Pro Met Glu Phe Gln Tyr	
275 280 285	
CTG CCA GAT ACA GAC GAT CGT CAC CGG ATT GAG GAG AAA CGT AAA AGG	912
Leu Pro Asp Thr Asp Asp Arg His Arg Ile Glu Glu Lys Arg Lys Arg	
290 295 300	
ACA TAT GAG ACC TTC AAG AGC ATC ATG AAG AAG AGT CCT TTC AGC GGA	960
Thr Tyr Glu Thr Phe Lys Ser Ile Met Lys Lys Ser Pro Phe Ser Gly	
305 310 315 320	
CCC ACC GAC CCC CGG CCT CCA CCT CGA CGC ATT GCT GTG CCT TCC CGC	1008
Pro Thr Asp Pro Arg Pro Pro Pro Arg Arg Ile Ala Val Pro Ser Arg	
325 330 335	
AGC TCA GCT TCT GTC CCC AAG CCA GCA CCC CAG CCC TAT CCC TTT ACG	1056
Ser Ser Ala Ser Val Pro Lys Pro Ala Pro Gln Pro Tyr Pro Phe Thr	
340 345 350	
TCA TCC CTG AGC ACC ATC AAC TAT GAT GAG TTT CCC ACC ATG GTG TTT	1104
Ser Ser Leu Ser Thr Ile Asn Tyr Asp Glu Phe Pro Thr Met Val Phe	
355 360 365	
CCT TCT GGG CAG ATC AGC CAG GCC TCG GCC TTG GCC CCG GCC CCT CCC	1152
Pro Ser Gly Gln Ile Ser Gln Ala Ser Ala Leu Ala Pro Ala Pro Pro	
370 375 380	
CAA GTC CTG CCC CAG GCT CCA GCC CCT GCC CCT GCT CCA GCC ATG GTA	1200
Gln Val Leu Pro Gln Ala Pro Ala Pro Ala Pro Ala Pro Ala Met Val	
385 390 395 400	
TCA GCT CTG GCC CAG GCC CCA GCC CCT GTC CCA GTC CTA GCC CCA GGC	1248
Ser Ala Leu Ala Gln Ala Pro Ala Pro Val Pro Val Leu Ala Pro Gly	
405 410 415	
CCT CCT CAG GCT GTG GCC CCA CCT GCC CCC AAG CCC ACC CAG GCT GGG	1296
Pro Pro Gln Ala Val Ala Pro Pro Ala Pro Lys Pro Thr Gln Ala Gly	
420 425 430	
GAA GGA ACG CTG TCA GAG GCC CTG CTG CAG CTG CAG TTT GAT GAT GAA	1344
Glu Gly Thr Leu Ser Glu Ala Leu Leu Gln Leu Gln Phe Asp Asp Glu	
435 440 445	
GAC CTG GGG GCC TTG CTT GGC AAC AGC ACA GAC CCA GCT GTG TTC ACA	1392

Asp	Leu	Gly	Ala	Leu	Leu	Gly	Asn	Ser	Thr	Asp	Pro	Ala	Val	Phe	Thr	
450						455				460						
GAC	CTG	GCA	TCC	GTC	GAC	AAC	TCC	GAG	TTT	CAG	CAG	CTG	CTG	AAC	CAG	1440
Asp	Leu	Ala	Ser	Val	Asp	Asn	Ser	Glu	Phe	Gln	Gln	Leu	Leu	Asn	Gln	
465					470					475					480	
GGC	ATA	CCT	GTG	GCC	CCC	CAC	ACA	ACT	GAG	CCC	ATG	CTG	ATG	GAG	TAC	1488
Gly	Ile	Pro	Val	Ala	Pro	His	Thr	Thr	Glu	Pro	Met	Leu	Met	Glu	Tyr	
				485					490					495		
CCT	GAG	GCT	ATA	ACT	CGC	CTA	GTG	ACA	GGG	GCC	CAG	AGG	CCC	CCC	GAC	1536
Pro	Glu	Ala	Ile	Thr	Arg	Leu	Val	Thr	Gly	Ala	Gln	Arg	Pro	Pro	Asp	
			500					505					510			
CCA	GCT	CCT	GCT	CCA	CTG	GGG	GCC	CCG	GGG	CTC	CCC	AAT	GGC	CTC	CTT	1584
Pro	Ala	Pro	Ala	Pro	Leu	Gly	Ala	Pro	Gly	Leu	Pro	Asn	Gly	Leu	Leu	
			515			520						525				
TCA	GGA	GAT	GAA	GAC	TTC	TCC	TCC	ATT	GCG	GAC	ATG	GAC	TTC	TCA	GCC	1632
Ser	Gly	Asp	Glu	Asp	Phe	Ser	Ser	Ile	Ala	Asp	Met	Asp	Phe	Ser	Ala	
	530					535					540					
CTG	CTG	AGT	CAG	ATC	AGC	TCC	TTG	GAT	CCA	CCG	GTC	GCC	ACC	ATG	GTG	1680
Leu	Leu	Ser	Gln	Ile	Ser	Ser	Leu	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	
545					550					555					560	
AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	GTC	GAG	1728
Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	
				565					570					575		
CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	GAG	GGC	1776
Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	
			580					585					590			
GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	TGC	ACC	1824
Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	
		595				600						605				
ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	CTG	ACC	1872
Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	
	610					615					620					
TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	CAG	CAC	1920
Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	Gln	His	
625					630					635					640	
GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	CGC	ACC	1968
Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	Arg	Thr	
				645					650					655		
ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	AAG	ACC	CGC	GCC	GAG	GTG	AAG	2016
Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	Val	Lys	
			660					665					670			
TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	CGC	ATC	GAG	CTG	AAG	GGC	ATC	GAC	2064
Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	Ile	Asp	
		675					680					685				

TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC	2112
Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr	
690 695 700	
AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC	2160
Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile	
705 710 715 720	
AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG	2208
Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln	
725 730 735	
CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG	2256
Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val	
740 745 750	
CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA	2304
Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys	
755 760 765	
GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC	2352
Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr	
770 775 780	
GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA	2394
Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys	
785 790 795	

## (2) INFORMATION FOR SEQ ID NO:141:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 797 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:141:

Met Asp Glu Leu Phe Pro Leu Ile Phe Pro Ala Glu Pro Ala Gln Ala	
1 5 10 15	
Ser Gly Pro Tyr Val Glu Ile Ile Glu Gln Pro Lys Gln Arg Gly Met	
20 25 30	
Arg Phe Arg Tyr Lys Cys Glu Gly Arg Ser Ala Gly Ser Ile Pro Gly	
35 40 45	
Glu Arg Ser Thr Asp Thr Thr Lys Thr His Pro Thr Ile Lys Ile Asn	
50 55 60	
Gly Tyr Thr Gly Pro Gly Thr Val Arg Ile Ser Leu Val Thr Lys Asp	
65 70 75 80	
Pro Pro His Arg Pro His Pro His Glu Leu Val Gly Lys Asp Cys Arg	
85 90 95	
Asp Gly Phe Tyr Glu Ala Glu Leu Cys Pro Asp Arg Cys Ile His Ser	
100 105 110	
Phe Gln Asn Leu Gly Ile Gln Cys Val Lys Lys Arg Asp Leu Glu Gln	

115	120	125
Ala Ile Ser Gln Arg Ile Gln Thr Asn Asn Asn Pro Phe Gln Val Pro		
130	135	140
Ile Glu Glu Gln Arg Gly Asp Tyr Asp Leu Asn Ala Val Arg Leu Cys		
145	150	155
Phe Gln Val Thr Val Arg Asp Pro Ser Gly Arg Pro Leu Arg Leu Pro		
165	170	175
Pro Val Leu Pro His Pro Ile Phe Asp Asn Arg Ala Pro Asn Thr Ala		
180	185	190
Glu Leu Lys Ile Cys Arg Val Asn Arg Asn Ser Gly Ser Cys Leu Gly		
195	200	205
Gly Asp Glu Ile Phe Leu Leu Cys Asp Lys Val Gln Lys Glu Asp Ile		
210	215	220
Glu Val Tyr Phe Thr Gly Pro Gly Trp Glu Ala Arg Gly Ser Phe Ser		
225	230	235
Gln Ala Asp Val His Arg Gln Val Ala Ile Val Phe Arg Thr Pro Pro		
245	250	255
Tyr Ala Asp Pro Ser Leu Gln Ala Pro Val Arg Val Ser Met Gln Leu		
260	265	270
Arg Arg Pro Ser Asp Arg Glu Leu Ser Glu Pro Met Glu Phe Gln Tyr		
275	280	285
Leu Pro Asp Thr Asp Asp Arg His Arg Ile Glu Glu Lys Arg Lys Arg		
290	295	300
Thr Tyr Glu Thr Phe Lys Ser Ile Met Lys Lys Ser Pro Phe Ser Gly		
305	310	315
Pro Thr Asp Pro Arg Pro Pro Pro Arg Arg Ile Ala Val Pro Ser Arg		
325	330	335
Ser Ser Ala Ser Val Pro Lys Pro Ala Pro Gln Pro Tyr Pro Phe Thr		
340	345	350
Ser Ser Leu Ser Thr Ile Asn Tyr Asp Glu Phe Pro Thr Met Val Phe		
355	360	365
Pro Ser Gly Gln Ile Ser Gln Ala Ser Ala Leu Ala Pro Ala Pro Pro		
370	375	380
Gln Val Leu Pro Gln Ala Pro Ala Pro Ala Pro Ala Pro Ala Met Val		
385	390	395
Ser Ala Leu Ala Gln Ala Pro Ala Pro Val Pro Val Leu Ala Pro Gly		
405	410	415
Pro Pro Gln Ala Val Ala Pro Pro Ala Pro Lys Pro Thr Gln Ala Gly		
420	425	430
Glu Gly Thr Leu Ser Glu Ala Leu Leu Gln Leu Gln Phe Asp Asp Glu		
435	440	445
Asp Leu Gly Ala Leu Leu Gly Asn Ser Thr Asp Pro Ala Val Phe Thr		
450	455	460
Asp Leu Ala Ser Val Asp Asn Ser Glu Phe Gln Gln Leu Leu Asn Gln		
465	470	475
Gly Ile Pro Val Ala Pro His Thr Thr Glu Pro Met Leu Met Glu Tyr		
485	490	495
Pro Glu Ala Ile Thr Arg Leu Val Thr Gly Ala Gln Arg Pro Pro Asp		
500	505	510
Pro Ala Pro Ala Pro Leu Gly Ala Pro Gly Leu Pro Asn Gly Leu Leu		
515	520	525
Ser Gly Asp Glu Asp Phe Ser Ser Ile Ala Asp Met Asp Phe Ser Ala		
530	535	540
Leu Leu Ser Gln Ile Ser Ser Leu Asp Pro Pro Val Ala Thr Met Val		
545	550	555
Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu		
565	570	575
Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly		

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2394 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence  
(B) LOCATION: 1...2391  
(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEO ID NO:142:

ATG	GTG	AGC	AAG	GGC	GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	48
Met	Val	Ser	Lys	Gly	Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	
1				5					10					15		
GTC	GAG	CTG	GAC	GGC	GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	96
Val	Glu	Leu	Asp	Gly	Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	
			20					25					30			
GAG	GGC	GAG	GGC	GAT	GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	144
Glu	Gly	Glu	Gly	Asp	Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	
		35					40					45				
TGC	ACC	ACC	GGC	AAG	CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	192

Cys	Thr	Thr	Gly	Lys	Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	
50						55					60					
CTG	ACC	TAC	GGC	GTG	CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	240
Leu	Thr	Tyr	Gly	Val	Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	
65					70					75					80	
CAG	CAC	GAC	TTC	TTC	AAG	TCC	GCC	ATG	CCC	GAA	GGC	TAC	GTC	CAG	GAG	288
Gln	His	Asp	Phe	Phe	Lys	Ser	Ala	Met	Pro	Glu	Gly	Tyr	Val	Gln	Glu	
				85					90					95		
CGC	ACC	ATC	TTC	TTC	AAG	GAC	GAC	GGC	AAC	TAC	AAG	ACC	CGC	GCC	GAG	336
Arg	Thr	Ile	Phe	Phe	Lys	Asp	Asp	Gly	Asn	Tyr	Lys	Thr	Arg	Ala	Glu	
			100					105					110			
GTG	AAG	TTC	GAG	GGC	GAC	ACC	CTG	GTG	AAC	CGC	ATC	GAG	CTG	AAG	GGC	384
Val	Lys	Phe	Glu	Gly	Asp	Thr	Leu	Val	Asn	Arg	Ile	Glu	Leu	Lys	Gly	
			115				120					125				
ATC	GAC	TTC	AAG	GAG	GAC	GGC	AAC	ATC	CTG	GGG	CAC	AAG	CTG	GAG	TAC	432
Ile	Asp	Phe	Lys	Glu	Asp	Gly	Asn	Ile	Leu	Gly	His	Lys	Leu	Glu	Tyr	
	130					135					140					
AAC	TAC	AAC	AGC	CAC	AAC	GTC	TAT	ATC	ATG	GCC	GAC	AAG	CAG	AAG	AAC	480
Asn	Tyr	Asn	Ser	His	Asn	Val	Tyr	Ile	Met	Ala	Asp	Lys	Gln	Lys	Asn	
145					150					155					160	
GGC	ATC	AAG	GTG	AAC	TTC	AAG	ATC	CGC	CAC	AAC	ATC	GAG	GAC	GGC	AGC	528
Gly	Ile	Lys	Val	Asn	Phe	Lys	Ile	Arg	His	Asn	Ile	Glu	Asp	Gly	Ser	
				165				170						175		
GTG	CAG	CTC	GCC	GAC	CAC	TAC	CAG	CAG	AAC	ACC	CCC	ATC	GGC	GAC	GGC	576
Val	Gln	Leu	Ala	Asp	His	Tyr	Gln	Gln	Asn	Thr	Pro	Ile	Gly	Asp	Gly	
			180					185					190			
CCC	GTG	CTG	CTG	CCC	GAC	AAC	CAC	TAC	CTG	AGC	ACC	CAG	TCC	GCC	CTG	624
Pro	Val	Leu	Leu	Pro	Asp	Asn	His	Tyr	Leu	Ser	Thr	Gln	Ser	Ala	Leu	
		195					200					205				
AGC	AAA	GAC	CCC	AAC	GAG	AAG	CGC	GAT	CAC	ATG	GTC	CTG	CTG	GAG	TTC	672
Ser	Lys	Asp	Pro	Asn	Glu	Lys	Arg	Asp	His	Met	Val	Leu	Leu	Glu	Phe	
	210					215				220						
GTG	ACC	GCC	GCC	GGG	ATC	ACT	CTC	GGC	ATG	GAC	GAG	CTG	TAC	AAG	TCC	720
Val	Thr	Ala	Ala	Gly	Ile	Thr	Leu	Gly	Met	Asp	Glu	Leu	Tyr	Lys	Ser	
225					230					235					240	
GGA	CTC	AGA	TCT	CGA	GCC	ATG	GAC	GAA	CTG	TTC	CCC	CTC	ATC	TTC	CCG	768
Gly	Leu	Arg	Ser	Arg	Ala	Met	Asp	Glu	Leu	Phe	Pro	Leu	Ile	Phe	Pro	
				245					250					255		
GCA	GAG	CCA	GCC	CAG	GCC	TCT	GGC	CCC	TAT	GTG	GAG	ATC	ATT	GAG	CAG	816
Ala	Glu	Pro	Ala	Gln	Ala	Ser	Gly	Pro	Tyr	Val	Glu	Ile	Ile	Glu	Gln	
			260					265					270			
CCC	AAG	CAG	CGG	GGC	ATG	CGC	TTC	CGC	TAC	AAG	TGC	GAG	GGG	CGC	TCC	864
Pro	Lys	Gln	Arg	Gly	Met	Arg	Phe	Arg	Tyr	Lys	Cys	Glu	Gly	Arg	Ser	
		275					280					285				

GCG GGC AGC ATC CCA GGC GAG AGG AGC ACA GAT ACC ACC AAG ACC CAC Ala Gly Ser Ile Pro Gly Glu Arg Ser Thr Asp Thr Thr Lys Thr His 290 295 300	912
CCC ACC ATC AAG ATC AAT GGC TAC ACA GGA CCA GGG ACA GTG CGC ATC Pro Thr Ile Lys Ile Asn Gly Tyr Thr Gly Pro Gly Thr Val Arg Ile 305 310 315 320	960
TCC CTG GTC ACC AAG GAC CCT CCT CAC CGG CCT CAC CCC CAC GAG CTT Ser Leu Val Thr Lys Asp Pro Pro His Arg Pro His Pro His Glu Leu 325 330 335	1008
GTA GGA AAG GAC TGC CGG GAT GGC TTC TAT GAG GCT GAG CTC TGC CCG Val Gly Lys Asp Cys Arg Asp Gly Phe Tyr Glu Ala Glu Leu Cys Pro 340 345 350	1056
GAC CGC TGC ATC CAC AGT TTC CAG AAC CTG GGA ATC CAG TGT GTG AAG Asp Arg Cys Ile His Ser Phe Gln Asn Leu Gly Ile Gln Cys Val Lys 355 360 365	1104
AAG CGG GAC CTG GAG CAG GCT ATC AGT CAG CGC ATC CAG ACC AAC AAC Lys Arg Asp Leu Glu Gln Ala Ile Ser Gln Arg Ile Gln Thr Asn Asn 370 375 380	1152
AAC CCC TTC CAA GTT CCT ATA GAA GAG CAG CGT GGG GAC TAC GAC CTG Asn Pro Phe Gln Val Pro Ile Glu Glu Gln Arg Gly Asp Tyr Asp Leu 385 390 395 400	1200
AAT GCT GTG CGG CTC TGC TTC CAG GTG ACA GTG CGG GAC CCA TCA GGC Asn Ala Val Arg Leu Cys Phe Gln Val Thr Val Arg Asp Pro Ser Gly 405 410 415	1248
AGG CCC CTC CGC CTG CCG CCT GTC CTT CCT CAT CCC ATC TTT GAC AAT Arg Pro Leu Arg Leu Pro Pro Val Leu Pro His Pro Ile Phe Asp Asn 420 425 430	1296
CGT GCC CCC AAC ACT GCC GAG CTC AAG ATC TGC CGA GTG AAC CGA AAC Arg Ala Pro Asn Thr Ala Glu Leu Lys Ile Cys Arg Val Asn Arg Asn 435 440 445	1344
TCT GGC AGC TGC CTC GGT GGG GAT GAG ATC TTC CTA CTG TGT GAC AAG Ser Gly Ser Cys Leu Gly Gly Asp Glu Ile Phe Leu Leu Cys Asp Lys 450 455 460	1392
GTG CAG AAA GAG GAC ATT GAG GTG TAT TTC ACG GGA CCA GGC TGG GAG Val Gln Lys Glu Asp Ile Glu Val Tyr Phe Thr Gly Pro Gly Trp Glu 465 470 475 480	1440
GCC CGA GGC TCC TTT TCG CAA GCT GAT GTG CAC CGA CAA GTG GCC ATT Ala Arg Gly Ser Phe Ser Gln Ala Asp Val His Arg Gln Val Ala Ile 485 490 495	1488
GTG TTC CGG ACC CCT CCC TAC GCA GAC CCC AGC CTG CAG GCT CCT GTG Val Phe Arg Thr Pro Pro Tyr Ala Asp Pro Ser Leu Gln Ala Pro Val 500 505 510	1536
CGT GTC TCC ATG CAG CTG CGG CGG CCT TCC GAC CGG GAG CTC AGT GAG	1584



Arg	Val	Ser	Met	Gln	Leu	Arg	Arg	Pro	Ser	Asp	Arg	Glu	Leu	Ser	Glu		
	515						520					525					
CCC	ATG	GAA	TTC	CAG	TAC	CTG	CCA	GAT	ACA	GAC	GAT	CGT	CAC	CGG	ATT	1632	
Pro	Met	Glu	Phe	Gln	Tyr	Leu	Pro	Asp	Thr	Asp	Asp	Arg	His	Arg	Ile		
	530					535					540						
GAG	GAG	AAA	CGT	AAA	AGG	ACA	TAT	GAG	ACC	TTC	AAG	AGC	ATC	ATG	AAG	1680	
Glu	Glu	Lys	Arg	Lys	Arg	Thr	Tyr	Glu	Thr	Phe	Lys	Ser	Ile	Met	Lys		
	545				550					555					560		
AAG	AGT	CCT	TTC	AGC	GGA	CCC	ACC	GAC	CCC	CGG	CCT	CCA	CCT	CGA	CGC	1728	
Lys	Ser	Pro	Phe	Ser	Gly	Pro	Thr	Asp	Pro	Arg	Pro	Pro	Pro	Arg	Arg		
			565						570					575			
ATT	GCT	GTG	CCT	TCC	CGC	AGC	TCA	GCT	TCT	GTC	CCC	AAG	CCA	GCA	CCC	1776	
Ile	Ala	Val	Pro	Ser	Arg	Ser	Ser	Ala	Ser	Val	Pro	Lys	Pro	Ala	Pro		
		580						585					590				
CAG	CCC	TAT	CCC	TTT	ACG	TCA	TCC	CTG	AGC	ACC	ATC	AAC	TAT	GAT	GAG	1824	
Gln	Pro	Tyr	Pro	Phe	Thr	Ser	Ser	Leu	Ser	Thr	Ile	Asn	Tyr	Asp	Glu		
		595					600					605					
TTT	CCC	ACC	ATG	GTG	TTT	CCT	TCT	GGG	CAG	ATC	AGC	CAG	GCC	TCG	GCC	1872	
Phe	Pro	Thr	Met	Val	Phe	Pro	Ser	Gly	Gln	Ile	Ser	Gln	Ala	Ser	Ala		
	610					615					620						
TTG	GCC	CCG	GCC	CCT	CCC	CAA	GTC	CTG	CCC	CAG	GCT	CCA	GCC	CCT	GCC	1920	
Leu	Ala	Pro	Ala	Pro	Pro	Gln	Val	Leu	Pro	Gln	Ala	Pro	Ala	Pro	Ala		
	625				630					635					640		
CCT	GCT	CCA	GCC	ATG	GTA	TCA	GCT	CTG	GCC	CAG	GCC	CCA	GCC	CCT	GTC	1968	
Pro	Ala	Pro	Ala	Met	Val	Ser	Ala	Leu	Ala	Gln	Ala	Pro	Ala	Pro	Val		
				645					650					655			
CCA	GTC	CTA	GCC	CCA	GGC	CCT	CCT	CAG	GCT	GTG	GCC	CCA	CCT	GCC	CCC	2016	
Pro	Val	Leu	Ala	Pro	Gly	Pro	Pro	Gln	Ala	Val	Ala	Pro	Pro	Ala	Pro		
			660					665					670				
AAG	CCC	ACC	CAG	GCT	GGG	GAA	GGA	ACG	CTG	TCA	GAG	GCC	CTG	CTG	CAG	2064	
Lys	Pro	Thr	Gln	Ala	Gly	Glu	Gly	Thr	Leu	Ser	Glu	Ala	Leu	Leu	Gln		
		675					680					685					
CTG	CAG	TTT	GAT	GAT	GAA	GAC	CTG	GGG	GCC	TTG	CTT	GGC	AAC	AGC	ACA	2112	
Leu	Gln	Phe	Asp	Asp	Glu	Asp	Leu	Gly	Ala	Leu	Leu	Gly	Asn	Ser	Thr		
	690					695					700						
GAC	CCA	GCT	GTG	TTC	ACA	GAC	CTG	GCA	TCC	GTC	GAC	AAC	TCC	GAG	TTT	2160	
Asp	Pro	Ala	Val	Phe	Thr	Asp	Leu	Ala	Ser	Val	Asp	Asn	Ser	Glu	Phe		
	705				710					715					720		
CAG	CAG	CTG	CTG	AAC	CAG	GGC	ATA	CCT	GTG	GCC	CCC	CAC	ACA	ACT	GAG	2208	
Gln	Gln	Leu	Leu	Asn	Gln	Gly	Ile	Pro	Val	Ala	Pro	His	Thr	Thr	Glu		
				725					730					735			
CCC	ATG	CTG	ATG	GAG	TAC	CCT	GAG	GCT	ATA	ACT	CGC	CTA	GTG	ACA	GGG	2256	
Pro	Met	Leu	Met	Glu	Tyr	Pro	Glu	Ala	Ile	Thr	Arg	Leu	Val	Thr	Gly		
			740					745						750			

GCC CAG AGG CCC CCC GAC CCA GCT CCT GCT CCA CTG GGG GCC CCG GGG 2304  
 Ala Gln Arg Pro Pro Asp Pro Ala Pro Ala Pro Leu Gly Ala Pro Gly  
 755 760 765

CTC CCC AAT GGC CTC CTT TCA GGA GAT GAA GAC TTC TCC TCC ATT GCG 2352  
 Leu Pro Asn Gly Leu Leu Ser Gly Asp Glu Asp Phe Ser Ser Ile Ala  
 770 775 780

GAC ATG GAC TTC TCA GCC CTG CTG AGT CAG ATC AGC TCC TAA 2394  
 Asp Met Asp Phe Ser Ala Leu Leu Ser Gln Ile Ser Ser  
 785 790 795

## (2) INFORMATION FOR SEQ ID NO:143:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 797 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:143:

Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu  
 1 5 10 15  
 Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly  
 20 25 30  
 Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile  
 35 40 45  
 Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr  
 50 55 60  
 Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys  
 65 70 75 80  
 Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu  
 85 90 95  
 Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu  
 100 105 110  
 Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly  
 115 120 125  
 Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr  
 130 135 140  
 Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn  
 145 150 155 160  
 Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser  
 165 170 175  
 Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly  
 180 185 190  
 Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu  
 195 200 205  
 Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe  
 210 215 220  
 Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys Ser  
 225 230 235 240  
 Gly Leu Arg Ser Arg Ala Met Asp Glu Leu Phe Pro Leu Ile Phe Pro

	245		250		255
Ala Glu Pro	Ala Gln Ala Ser Gly	Pro Tyr Val Glu Ile Ile Glu Gln			
	260	265		270	
Pro Lys Gln	Arg Gly Met Arg Phe Arg	Tyr Lys Cys Glu Gly Arg Ser			
	275	280		285	
Ala Gly Ser	Ile Pro Gly Glu Arg Ser Thr Asp	Thr Thr Lys Thr His			
	290	295		300	
Pro Thr Ile	Lys Ile Asn Gly Tyr Thr Gly	Pro Gly Thr Val Arg Ile			
	305	310		315	
Ser Leu Val	Thr Lys Asp Pro Pro His Arg	Pro His Pro His Glu Leu			
	325	330		335	
Val Gly Lys	Asp Cys Arg Asp Gly Phe Tyr	Glu Ala Glu Leu Cys Pro			
	340	345		350	
Asp Arg Cys	Ile His Ser Phe Gln Asn Leu Gly	Ile Gln Cys Val Lys			
	355	360		365	
Lys Arg Asp	Leu Glu Gln Ala Ile Ser Gln Arg	Ile Gln Thr Asn Asn			
	370	375		380	
Asn Pro Phe	Gln Val Pro Ile Glu Glu Gln Arg	Gly Asp Tyr Asp Leu			
	385	390		395	
Asn Ala Val	Arg Leu Cys Phe Gln Val Thr Val	Arg Asp Pro Ser Gly			
	405	410		415	
Arg Pro Leu	Arg Leu Pro Pro Val Leu Pro His	Pro Ile Phe Asp Asn			
	420	425		430	
Arg Ala Pro	Asn Thr Ala Glu Leu Lys Ile Cys	Arg Val Asn Arg Asn			
	435	440		445	
Ser Gly Ser	Cys Leu Gly Gly Asp Glu Ile Phe	Leu Leu Cys Asp Lys			
	450	455		460	
Val Gln Lys	Glu Asp Ile Glu Val Tyr Phe Thr	Gly Pro Gly Trp Glu			
	465	470		475	
Ala Arg Gly	Ser Phe Ser Gln Ala Asp Val His	Arg Gln Val Ala Ile			
	485	490		495	
Val Phe Arg	Thr Pro Pro Tyr Ala Asp Pro Ser	Leu Gln Ala Pro Val			
	500	505		510	
Arg Val Ser	Met Gln Leu Arg Arg Pro Ser Asp	Arg Glu Leu Ser Glu			
	515	520		525	
Pro Met Glu	Phe Gln Tyr Leu Pro Asp Thr Asp	Asp Arg His Arg Ile			
	530	535		540	
Glu Glu Lys	Arg Lys Arg Thr Tyr Glu Thr Phe	Lys Ser Ile Met Lys			
	545	550		555	
Lys Ser Pro	Phe Ser Gly Pro Thr Asp Pro Arg	Pro Pro Pro Arg Arg			
	565	570		575	
Ile Ala Val	Pro Ser Arg Ser Ser Ala Ser Val	Pro Lys Pro Ala Pro			
	580	585		590	
Gln Pro Tyr	Pro Phe Thr Ser Ser Leu Ser Thr	Ile Asn Tyr Asp Glu			
	595	600		605	
Phe Pro Thr	Met Val Phe Pro Ser Gly Gln Ile	Ser Gln Ala Ser Ala			
	610	615		620	
Leu Ala Pro	Ala Pro Pro Gln Val Leu Pro Gln	Ala Pro Ala Pro Ala			
	625	630		635	
Pro Ala Pro	Ala Met Val Ser Ala Leu Ala Gln	Ala Pro Ala Pro Val			
	645	650		655	
Pro Val Leu	Ala Pro Gly Pro Pro Gln Ala	Val Ala Pro Pro Ala Pro			
	660	665		670	
Lys Pro Thr	Gln Ala Gly Glu Gly Thr Leu Ser	Glu Ala Leu Leu Gln			
	675	680		685	
Leu Gln Phe	Asp Asp Glu Asp Leu Gly Ala Leu	Leu Gly Asn Ser Thr			
	690	695		700	
Asp Pro Ala	Val Phe Thr Asp Leu Ala Ser Val	Asp Asn Ser Glu Phe			

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705          710          715          720
Gln Gln Leu Leu Asn Gln Gly Ile Pro Val Ala Pro His Thr Thr Glu
          725          730          735
Pro Met Leu Met Glu Tyr Pro Glu Ala Ile Thr Arg Leu Val Thr Gly
          740          745          750
Ala Gln Arg Pro Pro Asp Pro Ala Pro Ala Pro Leu Gly Ala Pro Gly
          755          760          765
Leu Pro Asn Gly Leu Leu Ser Gly Asp Glu Asp Phe Ser Ser Ile Ala
          770          775          780
Asp Met Asp Phe Ser Ala Leu Leu Ser Gln Ile Ser Ser
785          790          795

```

## (2) INFORMATION FOR SEQ ID NO:144:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 3381 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...3378
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:144:

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ATG GAG CGG GCC GGC CCC AGC TTC GGG CAG CAG CGA CAG CAG CAG CAG      48
Met Glu Arg Ala Gly Pro Ser Phe Gly Gln Gln Arg Gln Gln Gln Gln
1          5          10          15

CCC CAG CAG CAG AAG CAG CAG CAG AGG GAT CAG GAC TCG GTC GAA GCA      96
Pro Gln Gln Gln Lys Gln Gln Gln Arg Asp Gln Asp Ser Val Glu Ala
          20          25          30

TGG CTG GAC GAT CAC TGG GAC TTT ACC TTC TCA TAC TTT GTT AGA AAA      144
Trp Leu Asp Asp His Trp Asp Phe Thr Phe Ser Tyr Phe Val Arg Lys
          35          40          45

GCC ACC AGA GAA ATG GTC AAT GCA TGG TTT GCT GAG AGA GTT CAC ACC      192
Ala Thr Arg Glu Met Val Asn Ala Trp Phe Ala Glu Arg Val His Thr
          50          55          60

ATC CCT GTG TGC AAG GAA GGT ATC AGA GGC CAC ACC GAA TCT TGC TCT      240
Ile Pro Val Cys Lys Glu Gly Ile Arg Gly His Thr Glu Ser Cys Ser
          65          70          75          80

TGT CCC TTG CAG CAG AGT CCT CGT GCA GAT AAC AGT GTC CCT GGA ACA      288
Cys Pro Leu Gln Gln Ser Pro Arg Ala Asp Asn Ser Val Pro Gly Thr

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85	90	95	
CCA ACC AGG AAA ATC TCT GCC TCT GAA TTT GAC CGG CCT CTT AGA CCC			336
Pro Thr Arg Lys Ile Ser Ala Ser Glu Phe Asp Arg Pro Leu Arg Pro			
100	105	110	
ATT GTT GTC AAG GAT TCT GAG GGA ACT GTG AGC TTC CTC TCT GAC TCA			384
Ile Val Val Lys Asp Ser Glu Gly Thr Val Ser Phe Leu Ser Asp Ser			
115	120	125	
GAA AAG AAG GAA CAG ATG CCT CTA ACC CCT CCA AGG TTT GAT CAT GAT			432
Glu Lys Lys Glu Gln Met Pro Leu Thr Pro Pro Arg Phe Asp His Asp			
130	135	140	
GAA GGG GAC CAG TGC TCA AGA CTC TTG GAA TTA GTG AAG GAT ATT TCT			480
Glu Gly Asp Gln Cys Ser Arg Leu Leu Glu Leu Val Lys Asp Ile Ser			
145	150	155	160
AGT CAT TTG GAT GTC ACA GCC TTA TGT CAC AAA ATT TTC TTG CAT ATC			528
Ser His Leu Asp Val Thr Ala Leu Cys His Lys Ile Phe Leu His Ile			
165	170	175	
CAT GGA CTG ATA TCT GCT GAC CGC TAT TCC CTG TTC CTT GTC TGT GAA			576
His Gly Leu Ile Ser Ala Asp Arg Tyr Ser Leu Phe Leu Val Cys Glu			
180	185	190	
GAC AGC TCC AAT GAC AAG TTT CTT ATC AGC CGC CTC TTT GAT GTT GCT			624
Asp Ser Ser Asn Asp Lys Phe Leu Ile Ser Arg Leu Phe Asp Val Ala			
195	200	205	
GAA GGT TCA ACA CTG GAA GAA GTT TCA AAT AAC TGT ATC CGC TTA GAA			672
Glu Gly Ser Thr Leu Glu Glu Val Ser Asn Asn Cys Ile Arg Leu Glu			
210	215	220	
TGG AAC AAA GGC ATT GTG GGA CAT GTG GCA GCG CTT GGT GAG CCC TTG			720
Trp Asn Lys Gly Ile Val Gly His Val Ala Ala Leu Gly Glu Pro Leu			
225	230	235	240
AAC ATC AAA GAT GCA TAT GAG GAT CCT CGG TTC AAT GCA GAA GTT GAC			768
Asn Ile Lys Asp Ala Tyr Glu Asp Pro Arg Phe Asn Ala Glu Val Asp			
245	250	255	
CAA ATT ACA GGC TAC AAG ACA CAA AGC ATT CTT TGT ATG CCA ATT AAG			816
Gln Ile Thr Gly Tyr Lys Thr Gln Ser Ile Leu Cys Met Pro Ile Lys			
260	265	270	
AAT CAT AGG GAA GAG GTT GTT GGT GTA GCC CAG GCC ATC AAC AAG AAA			864
Asn His Arg Glu Glu Val Val Gly Val Ala Gln Ala Ile Asn Lys Lys			
275	280	285	
TCA GGA AAC GGT GGG ACA TTT ACT GAA AAA GAT GAA AAG GAC TTT GCT			912
Ser Gly Asn Gly Gly Thr Phe Thr Glu Lys Asp Glu Lys Asp Phe Ala			
290	295	300	

GCT TAT TTG GCA TTT TGT GGT ATT GTT CTT CAT AAT GCT CAG CTC TAT	960
Ala Tyr Leu Ala Phe Cys Gly Ile Val Leu His Asn Ala Gln Leu Tyr	
305 310 315 320	
GAG ACT TCA CTG CTG GAG AAC AAG AGA AAT CAG GTG CTG CTT GAC CTT	1008
Glu Thr Ser Leu Leu Glu Asn Lys Arg Asn Gln Val Leu Leu Asp Leu	
325 330 335	
GCT AGT TTA ATT TTT GAA GAA CAA CAA TCA TTA GAA GTA ATT TTG AAG	1056
Ala Ser Leu Ile Phe Glu Glu Gln Gln Ser Leu Glu Val Ile Leu Lys	
340 345 350	
AAA ATA GCT GCC ACT ATT ATC TCT TTC ATG CAA GTG CAG AAA TGC ACC	1104
Lys Ile Ala Ala Thr Ile Ile Ser Phe Met Gln Val Gln Lys Cys Thr	
355 360 365	
ATT TTC ATA GTG GAT GAA GAT TGC TCC GAT TCT TTT TCT AGT GTG TTT	1152
Ile Phe Ile Val Asp Glu Asp Cys Ser Asp Ser Phe Ser Ser Val Phe	
370 375 380	
CAC ATG GAG TGT GAG GAA TTA GAA AAA TCA TCT GAT ACA TTA ACA AGG	1200
His Met Glu Cys Glu Glu Leu Glu Lys Ser Ser Asp Thr Leu Thr Arg	
385 390 395 400	
GAA CAT GAT GCA AAC AAA ATC AAT TAC ATG TAT GCT CAG TAT GTC AAA	1248
Glu His Asp Ala Asn Lys Ile Asn Tyr Met Tyr Ala Gln Tyr Val Lys	
405 410 415	
AAT ACT ATG GAA CCA CTT AAT ATC CCA GAT GTC AGT AAG GAT AAA AGA	1296
Asn Thr Met Glu Pro Leu Asn Ile Pro Asp Val Ser Lys Asp Lys Arg	
420 425 430	
TTT CCC TGG ACA ACT GAA AAT ACA GGA AAT GTA AAC CAG CAG TGC ATT	1344
Phe Pro Trp Thr Thr Glu Asn Thr Gly Asn Val Asn Gln Gln Cys Ile	
435 440 445	
AGA AGT TTG CTT TGT ACA CCT ATA AAA AAT GGA AAG AAG AAT AAA GTT	1392
Arg Ser Leu Leu Cys Thr Pro Ile Lys Asn Gly Lys Lys Asn Lys Val	
450 455 460	
ATA GGG GTT TGC CAA CTT GTT AAT AAG ATG GAG GAG AAT ACT GGC AAG	1440
Ile Gly Val Cys Gln Leu Val Asn Lys Met Glu Glu Asn Thr Gly Lys	
465 470 475 480	
GTT AAG CCT TTC AAC CGA AAT GAC GAA CAG TTT CTG GAA GCT TTT GTC	1488
Val Lys Pro Phe Asn Arg Asn Asp Glu Gln Phe Leu Glu Ala Phe Val	
485 490 495	
ATC TTT TGT GGC TTG GGG ATC CAG AAC ACG CAG ATG TAT GAA GCA GTG	1536
Ile Phe Cys Gly Leu Gly Ile Gln Asn Thr Gln Met Tyr Glu Ala Val	
500 505 510	
GAG AGA GCC ATG GCC AAG CAA ATG GTC ACA TTG GAG GTT CTG TCG TAT	1584
Glu Arg Ala Met Ala Lys Gln Met Val Thr Leu Glu Val Leu Ser Tyr	

515	520	525	
CAT GCT TCA GCA GCA GAG GAA GAA ACA AGA GAG CTA CAG TCG TTA GCG			1632
His Ala Ser Ala Ala Glu Glu Glu Thr Arg Glu Leu Gln Ser Leu Ala			
530	535	540	
GCT GCT GTG GTG CCA TCT GCC CAG ACC CTT AAA ATT ACT GAC TTT AGC			1680
Ala Ala Val Val Pro Ser Ala Gln Thr Leu Lys Ile Thr Asp Phe Ser			
545	550	555	560
TTC AGT GAC TTT GAG CTG TCT GAT CTG GAA ACA GCA CTG TGC ACA ATT			1728
Phe Ser Asp Phe Glu Leu Ser Asp Leu Glu Thr Ala Leu Cys Thr Ile			
565	570	575	
CGG ATG TTT ACT GAC CTC AAC CTT GTG CAG AAC TTC CAG ATG AAA CAT			1776
Arg Met Phe Thr Asp Leu Asn Leu Val Gln Asn Phe Gln Met Lys His			
580	585	590	
GAG GTT CTT TGC AGA TGG ATT TTA AGT GTT AAG AAG AAT TAT CGG AAG			1824
Glu Val Leu Cys Arg Trp Ile Leu Ser Val Lys Lys Asn Tyr Arg Lys			
595	600	605	
AAT GTT GCC TAT CAT AAT TGG AGA CAT GCC TTT AAT ACA GCT CAG TGC			1872
Asn Val Ala Tyr His Asn Trp Arg His Ala Phe Asn Thr Ala Gln Cys			
610	615	620	
ATG TTT GCT GCT CTA AAA GCA GGC AAA ATT CAG AAC AAG CTG ACT GAC			1920
Met Phe Ala Ala Leu Lys Ala Gly Lys Ile Gln Asn Lys Leu Thr Asp			
625	630	635	640
CTG GAG ATA CTT GCA TTG CTG ATT GCT GCA CTA AGC CAC GAT TTG GAT			1968
Leu Glu Ile Leu Ala Leu Leu Ile Ala Ala Leu Ser His Asp Leu Asp			
645	650	655	
CAC CGT GGT GTG AAT AAC TCT TAC ATA CAG CGA AGT GAA CAT CCA CTT			2016
His Arg Gly Val Asn Asn Ser Tyr Ile Gln Arg Ser Glu His Pro Leu			
660	665	670	
GCC CAG CTT TAC TGC CAT TCA ATC ATG GAA CAC CAT CAT TTT GAC CAG			2064
Ala Gln Leu Tyr Cys His Ser Ile Met Glu His His His Phe Asp Gln			
675	680	685	
TGC CTG ATG ATT CTT AAT AGT CCA GGC AAT CAG ATT CTC AGT GGC CTC			2112
Cys Leu Met Ile Leu Asn Ser Pro Gly Asn Gln Ile Leu Ser Gly Leu			
690	695	700	
TCC ATT GAA GAA TAT AAG ACC ACG TTG AAA ATA ATC AAG CAA GCT ATT			2160
Ser Ile Glu Glu Tyr Lys Thr Thr Leu Lys Ile Ile Lys Gln Ala Ile			
705	710	715	720
TTA GCT ACA GAC CTA GCA CTG TAC ATT AAG AGG CGA GGA GAA TTT TTT			2208
Leu Ala Thr Asp Leu Ala Leu Tyr Ile Lys Arg Arg Gly Glu Phe Phe			
725	730	735	

GAA CTT ATA AGA AAA AAT CAA TTC AAT TTG GAA GAT CCT CAT CAA AAG	2256
Glu Leu Ile Arg Lys Asn Gln Phe Asn Leu Glu Asp Pro His Gln Lys	
740 745 750	
GAG TTG TTT TTG GCA ATG CTG ATG ACA GCT TGT GAT CTT TCT GCA ATT	2304
Glu Leu Phe Leu Ala Met Leu Met Thr Ala Cys Asp Leu Ser Ala Ile	
755 760 765	
ACA AAA CCC TGG CCT ATT CAA CAA CGG ATA GCA GAA CTT GTA GCA ACT	2352
Thr Lys Pro Trp Pro Ile Gln Gln Arg Ile Ala Glu Leu Val Ala Thr	
770 775 780	
GAA TTT TTT GAT CAA GGA GAC AGA GAG AGA AAA GAA CTC AAC ATA GAA	2400
Glu Phe Phe Asp Gln Gly Asp Arg Glu Arg Lys Glu Leu Asn Ile Glu	
785 790 795 800	
CCC ACT GAT CTA ATG AAC AGG GAG AAG AAA AAC AAA ATC CCA AGT ATG	2448
Pro Thr Asp Leu Met Asn Arg Glu Lys Lys Asn Lys Ile Pro Ser Met	
805 810 815	
CAA GTT GGG TTC ATA GAT GCC ATC TGC TTG CAA CTG TAT GAG GCC CTG	2496
Gln Val Gly Phe Ile Asp Ala Ile Cys Leu Gln Leu Tyr Glu Ala Leu	
820 825 830	
ACC CAC GTG TCA GAG GAC TGT TTC CCT TTG CTA GAT GGC TGC AGA AAG	2544
Thr His Val Ser Glu Asp Cys Phe Pro Leu Leu Asp Gly Cys Arg Lys	
835 840 845	
AAC AGG CAG AAA TGG CAG GCC CTT GCA GAA CAG CAG GAG AAG ATG CTG	2592
Asn Arg Gln Lys Trp Gln Ala Leu Ala Glu Gln Gln Glu Lys Met Leu	
850 855 860	
ATT AAT GGG GAA AGC GGC CAG GCC AAG CGG AAC TGG GTA CCG CGG GCC	2640
Ile Asn Gly Glu Ser Gly Gln Ala Lys Arg Asn Trp Val Pro Arg Ala	
865 870 875 880	
CGG GAT CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC GAG GAG CTG TTC	2688
Arg Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe	
885 890 895	
ACC GGG GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC GAC GTA AAC GGC	2736
Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly	
900 905 910	
CAC AAG TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT GCC ACC TAC GGC	2784
His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly	
915 920 925	
AAG CTG ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG CCC	2832
Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro	
930 935 940	
TGG CCC ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC AGC	2880
Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser	



945	950	955	960	
CGC TAC CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG				2928
Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met				
	965	970	975	
CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC				2976
Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly				
	980	985	990	
AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG				3024
Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val				
	995	1000	1005	
AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC				3072
Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile				
	1010	1015	1020	
CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC				3120
Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile				
1025	1030	1035	1040	
ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC				3168
Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg				
	1045	1050	1055	
CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG				3216
His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln				
	1060	1065	1070	
AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC				3264
Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr				
	1075	1080	1085	
CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT				3312
Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp				
	1090	1095	1100	
CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC				3360
His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly				
1105	1110	1115	1120	
ATG GAC GAG CTG TAC AAG TAA				3381
Met Asp Glu Leu Tyr Lys				
	1125			

## (2) INFORMATION FOR SEQ ID NO:145:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 1126 amino acids
  - (B) TYPE: amino acid
  - (C) STRANDEDNESS: single
  - (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(v) FRAGMENT TYPE: internal

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:145:

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Met Glu Arg Ala Gly Pro Ser Phe Gly Gln Gln Arg Gln Gln Gln
 1          5          10          15
Pro Gln Gln Gln Lys Gln Gln Gln Arg Asp Gln Asp Ser Val Glu Ala
 20          25          30
Trp Leu Asp Asp His Trp Asp Phe Thr Phe Ser Tyr Phe Val Arg Lys
 35          40          45
Ala Thr Arg Glu Met Val Asn Ala Trp Phe Ala Glu Arg Val His Thr
 50          55          60
Ile Pro Val Cys Lys Glu Gly Ile Arg Gly His Thr Glu Ser Cys Ser
 65          70          75          80
Cys Pro Leu Gln Gln Ser Pro Arg Ala Asp Asn Ser Val Pro Gly Thr
 85          90          95
Pro Thr Arg Lys Ile Ser Ala Ser Glu Phe Asp Arg Pro Leu Arg Pro
100          105          110
Ile Val Val Lys Asp Ser Glu Gly Thr Val Ser Phe Leu Ser Asp Ser
115          120          125
Glu Lys Lys Glu Gln Met Pro Leu Thr Pro Pro Arg Phe Asp His Asp
130          135          140
Glu Gly Asp Gln Cys Ser Arg Leu Leu Glu Leu Val Lys Asp Ile Ser
145          150          155          160
Ser His Leu Asp Val Thr Ala Leu Cys His Lys Ile Phe Leu His Ile
165          170          175
His Gly Leu Ile Ser Ala Asp Arg Tyr Ser Leu Phe Leu Val Cys Glu
180          185          190
Asp Ser Ser Asn Asp Lys Phe Leu Ile Ser Arg Leu Phe Asp Val Ala
195          200          205
Glu Gly Ser Thr Leu Glu Glu Val Ser Asn Asn Cys Ile Arg Leu Glu
210          215          220
Trp Asn Lys Gly Ile Val Gly His Val Ala Ala Leu Gly Glu Pro Leu
225          230          235          240
Asn Ile Lys Asp Ala Tyr Glu Asp Pro Arg Phe Asn Ala Glu Val Asp
245          250          255
Gln Ile Thr Gly Tyr Lys Thr Gln Ser Ile Leu Cys Met Pro Ile Lys
260          265          270
Asn His Arg Glu Glu Val Val Gly Val Ala Gln Ala Ile Asn Lys Lys
275          280          285
Ser Gly Asn Gly Gly Thr Phe Thr Glu Lys Asp Glu Lys Asp Phe Ala
290          295          300
Ala Tyr Leu Ala Phe Cys Gly Ile Val Leu His Asn Ala Gln Leu Tyr
305          310          315          320
Glu Thr Ser Leu Leu Glu Asn Lys Arg Asn Gln Val Leu Leu Asp Leu
325          330          335
Ala Ser Leu Ile Phe Glu Glu Gln Gln Ser Leu Glu Val Ile Leu Lys
340          345          350
Lys Ile Ala Ala Thr Ile Ile Ser Phe Met Gln Val Gln Lys Cys Thr
355          360          365
Ile Phe Ile Val Asp Glu Asp Cys Ser Asp Ser Phe Ser Ser Val Phe
370          375          380

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His Met Glu Cys Glu Glu Leu Glu Lys Ser Ser Asp Thr Leu Thr Arg  
 385 390 395 400  
 Glu His Asp Ala Asn Lys Ile Asn Tyr Met Tyr Ala Gln Tyr Val Lys  
 405 410 415  
 Asn Thr Met Glu Pro Leu Asn Ile Pro Asp Val Ser Lys Asp Lys Arg  
 420 425 430  
 Phe Pro Trp Thr Thr Glu Asn Thr Gly Asn Val Asn Gln Gln Cys Ile  
 435 440 445  
 Arg Ser Leu Leu Cys Thr Pro Ile Lys Asn Gly Lys Lys Asn Lys Val  
 450 455 460  
 Ile Gly Val Cys Gln Leu Val Asn Lys Met Glu Glu Asn Thr Gly Lys  
 465 470 475 480  
 Val Lys Pro Phe Asn Arg Asn Asp Glu Gln Phe Leu Glu Ala Phe Val  
 485 490 495  
 Ile Phe Cys Gly Leu Gly Ile Gln Asn Thr Gln Met Tyr Glu Ala Val  
 500 505 510  
 Glu Arg Ala Met Ala Lys Gln Met Val Thr Leu Glu Val Leu Ser Tyr  
 515 520 525  
 His Ala Ser Ala Ala Glu Glu Glu Thr Arg Glu Leu Gln Ser Leu Ala  
 530 535 540  
 Ala Ala Val Val Pro Ser Ala Gln Thr Leu Lys Ile Thr Asp Phe Ser  
 545 550 555 560  
 Phe Ser Asp Phe Glu Leu Ser Asp Leu Glu Thr Ala Leu Cys Thr Ile  
 565 570 575  
 Arg Met Phe Thr Asp Leu Asn Leu Val Gln Asn Phe Gln Met Lys His  
 580 585 590  
 Glu Val Leu Cys Arg Trp Ile Leu Ser Val Lys Lys Asn Tyr Arg Lys  
 595 600 605  
 Asn Val Ala Tyr His Asn Trp Arg His Ala Phe Asn Thr Ala Gln Cys  
 610 615 620  
 Met Phe Ala Ala Leu Lys Ala Gly Lys Ile Gln Asn Lys Leu Thr Asp  
 625 630 635 640  
 Leu Glu Ile Leu Ala Leu Leu Ile Ala Ala Leu Ser His Asp Leu Asp  
 645 650 655  
 His Arg Gly Val Asn Asn Ser Tyr Ile Gln Arg Ser Glu His Pro Leu  
 660 665 670  
 Ala Gln Leu Tyr Cys His Ser Ile Met Glu His His His Phe Asp Gln  
 675 680 685  
 Cys Leu Met Ile Leu Asn Ser Pro Gly Asn Gln Ile Leu Ser Gly Leu  
 690 695 700  
 Ser Ile Glu Glu Tyr Lys Thr Thr Leu Lys Ile Ile Lys Gln Ala Ile  
 705 710 715 720  
 Leu Ala Thr Asp Leu Ala Leu Tyr Ile Lys Arg Arg Gly Glu Phe Phe  
 725 730 735  
 Glu Leu Ile Arg Lys Asn Gln Phe Asn Leu Glu Asp Pro His Gln Lys  
 740 745 750  
 Glu Leu Phe Leu Ala Met Leu Met Thr Ala Cys Asp Leu Ser Ala Ile  
 755 760 765  
 Thr Lys Pro Trp Pro Ile Gln Arg Ile Ala Glu Leu Val Ala Thr  
 770 775 780  
 Glu Phe Phe Asp Gln Gly Asp Arg Glu Arg Lys Glu Leu Asn Ile Glu  
 785 790 795 800  
 Pro Thr Asp Leu Met Asn Arg Glu Lys Lys Asn Lys Ile Pro Ser Met  
 805 810 815

Gln Val Gly Phe Ile Asp Ala Ile Cys Leu Gln Leu Tyr Glu Ala Leu  
 820 825 830  
 Thr His Val Ser Glu Asp Cys Phe Pro Leu Leu Asp Gly Cys Arg Lys  
 835 840 845  
 Asn Arg Gln Lys Trp Gln Ala Leu Ala Glu Gln Gln Glu Lys Met Leu  
 850 855 860  
 Ile Asn Gly Glu Ser Gly Gln Ala Lys Arg Asn Trp Val Pro Arg Ala  
 865 870 875 880  
 Arg Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe  
 885 890 895  
 Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly  
 900 905 910  
 His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly  
 915 920 925  
 Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro  
 930 935 940  
 Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser  
 945 950 955 960  
 Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met  
 965 970 975  
 Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly  
 980 985 990  
 Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val  
 995 1000 1005  
 Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile  
 1010 1015 1020  
 Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile  
 1025 1030 1035 1040  
 Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg  
 1045 1050 1055  
 His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln  
 1060 1065 1070  
 Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr  
 1075 1080 1085  
 Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp  
 1090 1095 1100  
 His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly  
 1105 1110 1115 1120  
 Met Asp Glu Leu Tyr Lys  
 1125

## (2) INFORMATION FOR SEQ ID NO:146:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2760 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2757

## (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:146:

ATG GCT GAC CCG GCT GCG GGG CCG CCG CCG AGC GAG GGC GAG GAG AGC	48
Met Ala Asp Pro Ala Ala Gly Pro Pro Pro Ser Glu Gly Glu Glu Ser	
1 5 10 15	
ACC GTG CGC TTC GCC CGC AAA GGC GCC CTC CGG CAG AAG AAC GTG CAT	96
Thr Val Arg Phe Ala Arg Lys Gly Ala Leu Arg Gln Lys Asn Val His	
20 25 30	
GAG GTC AAG AAC CAC AAA TTC ACC GCC CGC TTC TTC AAG CAG CCC ACC	144
Glu Val Lys Asn His Lys Phe Thr Ala Arg Phe Phe Lys Gln Pro Thr	
35 40 45	
TTC TGC AGC CAC TGC ACC GAC TTC ATC TGG GGC TTC GGG AAG CAG GGA	192
Phe Cys Ser His Cys Thr Asp Phe Ile Trp Gly Phe Gly Lys Gln Gly	
50 55 60	
TTC CAG TGC CAA GTT TGC TGC TTT GTG GTG CAC AAG CGG TGC CAT GAA	240
Phe Gln Cys Gln Val Cys Cys Phe Val Val His Lys Arg Cys His Glu	
65 70 75 80	
TTT GTC ACA TTC TCC TGC CCT GGC GCT GAC AAG GGT CCA GCC TCC GAT	288
Phe Val Thr Phe Ser Cys Pro Gly Ala Asp Lys Gly Pro Ala Ser Asp	
85 90 95	
GAC CCC CGC AGC AAA CAC AAG TTT AAG ATC CAC ACG TAC TCC AGC CCC	336
Asp Pro Arg Ser Lys His Lys Phe Lys Ile His Thr Tyr Ser Ser Pro	
100 105 110	
ACG TTT TGT GAC CAC TGT GGG TCA CTG CTG TAT GGA CTC ATC CAC CAG	384
Thr Phe Cys Asp His Cys Gly Ser Leu Leu Tyr Gly Leu Ile His Gln	
115 120 125	
GGG ATG AAA TGT GAC ACC TGC ATG ATG AAT GTG CAC AAG CGC TGC GTG	432
Gly Met Lys Cys Asp Thr Cys Met Met Asn Val His Lys Arg Cys Val	
130 135 140	
ATG AAT GTT CCC AGC CTG TGT GGC ACG GAC CAC ACG GAG CGC CGC GGC	480
Met Asn Val Pro Ser Leu Cys Gly Thr Asp His Thr Glu Arg Arg Gly	
145 150 155 160	
CGC ATC TAC ATC CAG GCC CAC ATC GAC AGG GAC GTC CTC ATT GTC CTC	528
Arg Ile Tyr Ile Gln Ala His Ile Asp Arg Asp Val Leu Ile Val Leu	
165 170 175	
GTA AGA GAT GCT AAA AAC CTT GTA CCT ATG GAC CCC AAT GGC CTG TCA	576
Val Arg Asp Ala Lys Asn Leu Val Pro Met Asp Pro Asn Gly Leu Ser	
180 185 190	
GAT CCC TAC GTA AAA CTG AAA CTG ATT CCC GAT CCC AAA AGT GAG AGC	624
Asp Pro Tyr Val Lys Leu Lys Leu Ile Pro Asp Pro Lys Ser Glu Ser	

195	200	205	
AAA CAG AAG ACC AAA ACC ATC AAA TGC TCC CTC AAC CCT GAG TGG AAT			672
Lys Gln Lys Thr Lys Thr Ile Lys Cys Ser Leu Asn Pro Glu Trp Asn			
210	215	220	
GAG ACA TTT AGA TTT CAG CTG AAA GAA TCG GAC AAA GAC AGA AGA CTG			720
Glu Thr Phe Arg Phe Gln Leu Lys Glu Ser Asp Lys Asp Arg Arg Leu			
225	230	235	240
TCA GTA GAG ATT TGG GAT TGG GAT TTG ACC AGC AGG AAT GAC TTC ATG			768
Ser Val Glu Ile Trp Asp Trp Asp Leu Thr Ser Arg Asn Asp Phe Met			
245	250	255	
GGA TCT TTG TCC TTT GGG ATT TCT GAA CTT CAG AAG GCC AGT GTT GAT			816
Gly Ser Leu Ser Phe Gly Ile Ser Glu Leu Gln Lys Ala Ser Val Asp			
260	265	270	
GGC TGG TTT AAG TTA CTG AGC CAG GAG GAA GGC GAG TAC TTC AAT GTG			864
Gly Trp Phe Lys Leu Leu Ser Gln Glu Glu Gly Glu Tyr Phe Asn Val			
275	280	285	
CCT GTG CCA CCA GAA GGA AGT GAG GCC AAT GAA GAA CTG CGG CAG AAA			912
Pro Val Pro Pro Glu Gly Ser Glu Ala Asn Glu Glu Leu Arg Gln Lys			
290	295	300	
TTT GAG AGG GCC AAG ATC AGT CAG GGA ACC AAG GTC CCG GAA GAA AAG			960
Phe Glu Arg Ala Lys Ile Ser Gln Gly Thr Lys Val Pro Glu Glu Lys			
305	310	315	320
ACG ACC AAC ACT GTC TCC AAA TTT GAC AAC AAT GGC AAC AGA GAC CGG			1008
Thr Thr Asn Thr Val Ser Lys Phe Asp Asn Asn Gly Asn Arg Asp Arg			
325	330	335	
ATG AAA CTG ACC GAT TTT AAC TTC CTA ATG GTG CTG GGG AAA GGC AGC			1056
Met Lys Leu Thr Asp Phe Asn Phe Leu Met Val Leu Gly Lys Gly Ser			
340	345	350	
TTT GGC AAG GTC ATG CTT TCA GAA CGA AAA GGC ACA GAT GAG CTC TAT			1104
Phe Gly Lys Val Met Leu Ser Glu Arg Lys Gly Thr Asp Glu Leu Tyr			
355	360	365	
GCT GTG AAG ATC CTG AAG AAG GAC GTT GTG ATC CAA GAT GAT GAC GTG			1152
Ala Val Lys Ile Leu Lys Lys Asp Val Val Ile Gln Asp Asp Asp Val			
370	375	380	
GAG TGC ACT ATG GTG GAG AAG CGG GTG TTG GCC CTG CCT GGG AAG CCG			1200
Glu Cys Thr Met Val Glu Lys Arg Val Leu Ala Leu Pro Gly Lys Pro			
385	390	395	400
CCC TTC CTG ACC CAG CTC CAC TCC TGC TTC CAG ACC ATG GAC CGC CTG			1248
Pro Phe Leu Thr Gln Leu His Ser Cys Phe Gln Thr Met Asp Arg Leu			
405	410	415	

TAC TTT GTG ATG GAG TAC GTG AAT GGG GGC GAC CTC ATG TAT CAC ATC Tyr Phe Val Met Glu Tyr Val Asn Gly Gly Asp Leu Met Tyr His Ile 420 425 430	1296
CAG CAA GTC GGC CGG TTC AAG GAG CCC CAT GCT GTA TTT TAC GCT GCA Gln Gln Val Gly Arg Phe Lys Glu Pro His Ala Val Phe Tyr Ala Ala 435 440 445	1344
GAA ATT GCC ATC GGT CTG TTC TTC TTA CAG AGT AAG GGC ATC ATT TAC Glu Ile Ala Ile Gly Leu Phe Phe Leu Gln Ser Lys Gly Ile Ile Tyr 450 455 460	1392
CGT GAC CTA AAA CTT GAC AAC GTG ATG CTC GAT TCT GAG GGA CAC ATC Arg Asp Leu Lys Leu Asp Asn Val Met Leu Asp Ser Glu Gly His Ile 465 470 475 480	1440
AAG ATT GCC GAT TTT GGC ATG TGT AAG GAA AAC ATC TGG GAT GGG GTG Lys Ile Ala Asp Phe Gly Met Cys Lys Glu Asn Ile Trp Asp Gly Val 485 490 495	1488
ACA ACC AAG ACA TTC TGT GGC ACT CCA GAC TAC ATC GCC CCC GAG ATA Thr Thr Lys Thr Phe Cys Gly Thr Pro Asp Tyr Ile Ala Pro Glu Ile 500 505 510	1536
ATT GCT TAT CAG CCC TAT GGG AAG TCC GTG GAT TGG TGG GCA TTT GGA Ile Ala Tyr Gln Pro Tyr Gly Lys Ser Val Asp Trp Trp Ala Phe Gly 515 520 525	1584
GTC CTG CTG TAT GAA ATG TTG GCT GGG CAG GCA CCC TTT GAA GGG GAG Val Leu Leu Tyr Glu Met Leu Ala Gly Gln Ala Pro Phe Glu Gly Glu 530 535 540	1632
GAT GAA GAT GAA CTC TTC CAA TCC ATC ATG GAA CAC AAC GTA GCC TAT Asp Glu Asp Glu Leu Phe Gln Ser Ile Met Glu His Asn Val Ala Tyr 545 550 555 560	1680
CCC AAG TCT ATG TCC AAG GAA GCT GTG GCC ATC TGC AAA GGG CTG ATG Pro Lys Ser Met Ser Lys Glu Ala Val Ala Ile Cys Lys Gly Leu Met 565 570 575	1728
ACC AAA CAC CCA GGC AAA CGT CTG GGT TGT GGA CCT GAA GGC GAA CGT Thr Lys His Pro Gly Lys Arg Leu Gly Cys Gly Pro Glu Gly Glu Arg 580 585 590	1776
GAT ATC AAA GAG CAT GCA TTT TTC CGG TAT ATT GAT TGG GAG AAA CTT Asp Ile Lys Glu His Ala Phe Phe Arg Tyr Ile Asp Trp Glu Lys Leu 595 600 605	1824
GAA CGC AAA GAG ATC CAG CCC CCT TAT AAG CCA AAA GCT TGT GGG CGA Glu Arg Lys Glu Ile Gln Pro Pro Tyr Lys Pro Lys Ala Cys Gly Arg 610 615 620	1872
AAT GCT GAA AAC TTC GAC CGA TTT TTC ACC CGC CAT CCA CCA GTC CTA Asn Ala Glu Asn Phe Asp Arg Phe Phe Thr Arg His Pro Pro Val Leu	1920

625	630	635	640	
ACA CCT CCC GAC CAG GAA GTC ATC AGG AAT ATT GAC CAA TCA GAA TTC				1968
Thr Pro Pro Asp Gln Glu Val Ile Arg Asn Ile Asp Gln Ser Glu Phe				
645	650	655		
GAA GGA TTT TCC TTT GTT AAC TCT GAA TTT TTA AAA CCC GAA GTC AAG				2016
Glu Gly Phe Ser Phe Val Asn Ser Glu Phe Leu Lys Pro Glu Val Lys				
660	665	670		
AGC TCG GAT CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC GAG GAG CTG				2064
Ser Ser Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu				
675	680	685		
TTC ACC GGG GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC GAC GTA AAC				2112
Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn				
690	695	700		
GGC CAC AAG TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT GCC ACC TAC				2160
Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr				
705	710	715	720	
GGC AAG CTG ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG				2208
Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val				
725	730	735		
CCC TGG CCC ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC				2256
Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe				
740	745	750		
AGC CGC TAC CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC				2304
Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala				
755	760	765		
ATG CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC				2352
Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp				
770	775	780		
GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG				2400
Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu				
785	790	795	800	
GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC				2448
Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn				
805	810	815		
ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT				2496
Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr				
820	825	830		
ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC				2544
Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile				
835	840	845		



CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG 2592  
 Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln  
 850 855 860

CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC 2640  
 Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His  
 865 870 875 880

TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC 2688  
 Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg  
 885 890 895

GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC 2736  
 Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu  
 900 905 910

GGC ATG GAC GAG CTG TAC AAG TAA 2760  
 Gly Met Asp Glu Leu Tyr Lys  
 915

## (2) INFORMATION FOR SEQ ID NO:147:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 919 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:147:

Met Ala Asp Pro Ala Ala Gly Pro Pro Pro Ser Glu Gly Glu Glu Ser  
 1 5 10 15  
 Thr Val Arg Phe Ala Arg Lys Gly Ala Leu Arg Gln Lys Asn Val His  
 20 25 30  
 Glu Val Lys Asn His Lys Phe Thr Ala Arg Phe Phe Lys Gln Pro Thr  
 35 40 45  
 Phe Cys Ser His Cys Thr Asp Phe Ile Trp Gly Phe Gly Lys Gln Gly  
 50 55 60  
 Phe Gln Cys Gln Val Cys Cys Phe Val Val His Lys Arg Cys His Glu  
 65 70 75 80  
 Phe Val Thr Phe Ser Cys Pro Gly Ala Asp Lys Gly Pro Ala Ser Asp  
 85 90 95  
 Asp Pro Arg Ser Lys His Lys Phe Lys Ile His Thr Tyr Ser Ser Pro  
 100 105 110  
 Thr Phe Cys Asp His Cys Gly Ser Leu Leu Tyr Gly Leu Ile His Gln  
 115 120 125  
 Gly Met Lys Cys Asp Thr Cys Met Met Asn Val His Lys Arg Cys Val  
 130 135 140  
 Met Asn Val Pro Ser Leu Cys Gly Thr Asp His Thr Glu Arg Arg Gly  
 145 150 155 160

Arg Ile Tyr Ile Gln Ala His Ile Asp Arg Asp Val Leu Ile Val Leu  
 165 170 175  
 Val Arg Asp Ala Lys Asn Leu Val Pro Met Asp Pro Asn Gly Leu Ser  
 180 185 190  
 Asp Pro Tyr Val Lys Leu Lys Leu Ile Pro Asp Pro Lys Ser Glu Ser  
 195 200 205  
 Lys Gln Lys Thr Lys Thr Ile Lys Cys Ser Leu Asn Pro Glu Trp Asn  
 210 215 220  
 Glu Thr Phe Arg Phe Gln Leu Lys Glu Ser Asp Lys Asp Arg Arg Leu  
 225 230 235 240  
 Ser Val Glu Ile Trp Asp Trp Asp Leu Thr Ser Arg Asn Asp Phe Met  
 245 250 255  
 Gly Ser Leu Ser Phe Gly Ile Ser Glu Leu Gln Lys Ala Ser Val Asp  
 260 265 270  
 Gly Trp Phe Lys Leu Leu Ser Gln Glu Glu Gly Glu Tyr Phe Asn Val  
 275 280 285  
 Pro Val Pro Pro Glu Gly Ser Glu Ala Asn Glu Glu Leu Arg Gln Lys  
 290 295 300  
 Phe Glu Arg Ala Lys Ile Ser Gln Gly Thr Lys Val Pro Glu Glu Lys  
 305 310 315 320  
 Thr Thr Asn Thr Val Ser Lys Phe Asp Asn Asn Gly Asn Arg Asp Arg  
 325 330 335  
 Met Lys Leu Thr Asp Phe Asn Phe Leu Met Val Leu Gly Lys Gly Ser  
 340 345 350  
 Phe Gly Lys Val Met Leu Ser Glu Arg Lys Gly Thr Asp Glu Leu Tyr  
 355 360 365  
 Ala Val Lys Ile Leu Lys Lys Asp Val Val Ile Gln Asp Asp Asp Val  
 370 375 380  
 Glu Cys Thr Met Val Glu Lys Arg Val Leu Ala Leu Pro Gly Lys Pro  
 385 390 395 400  
 Pro Phe Leu Thr Gln Leu His Ser Cys Phe Gln Thr Met Asp Arg Leu  
 405 410 415  
 Tyr Phe Val Met Glu Tyr Val Asn Gly Gly Asp Leu Met Tyr His Ile  
 420 425 430  
 Gln Gln Val Gly Arg Phe Lys Glu Pro His Ala Val Phe Tyr Ala Ala  
 435 440 445  
 Glu Ile Ala Ile Gly Leu Phe Phe Leu Gln Ser Lys Gly Ile Ile Tyr  
 450 455 460  
 Arg Asp Leu Lys Leu Asp Asn Val Met Leu Asp Ser Glu Gly His Ile  
 465 470 475 480  
 Lys Ile Ala Asp Phe Gly Met Cys Lys Glu Asn Ile Trp Asp Gly Val  
 485 490 495  
 Thr Thr Lys Thr Phe Cys Gly Thr Pro Asp Tyr Ile Ala Pro Glu Ile  
 500 505 510  
 Ile Ala Tyr Gln Pro Tyr Gly Lys Ser Val Asp Trp Trp Ala Phe Gly  
 515 520 525  
 Val Leu Leu Tyr Glu Met Leu Ala Gly Gln Ala Pro Phe Glu Gly Glu  
 530 535 540  
 Asp Glu Asp Glu Leu Phe Gln Ser Ile Met Glu His Asn Val Ala Tyr  
 545 550 555 560  
 Pro Lys Ser Met Ser Lys Glu Ala Val Ala Ile Cys Lys Gly Leu Met  
 565 570 575  
 Thr Lys His Pro Gly Lys Arg Leu Gly Cys Gly Pro Glu Gly Glu Arg  
 580 585 590

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Asp Ile Lys Glu His Ala Phe Phe Arg Tyr Ile Asp Trp Glu Lys Leu
595                                600                                605
Glu Arg Lys Glu Ile Gln Pro Pro Tyr Lys Pro Lys Ala Cys Gly Arg
610                                615                                620
Asn Ala Glu Asn Phe Asp Arg Phe Phe Thr Arg His Pro Pro Val Leu
625                                630                                635                                640
Thr Pro Pro Asp Gln Glu Val Ile Arg Asn Ile Asp Gln Ser Glu Phe
645                                650                                655
Glu Gly Phe Ser Phe Val Asn Ser Glu Phe Leu Lys Pro Glu Val Lys
660                                665                                670
Ser Ser Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu
675                                680                                685
Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn
690                                695                                700
Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr
705                                710                                715                                720
Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val
725                                730                                735
Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe
740                                745                                750
Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe Lys Ser Ala
755                                760                                765
Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp
770                                775                                780
Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu
785                                790                                795                                800
Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn
805                                810                                815
Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr
820                                825                                830
Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile
835                                840                                845
Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln
850                                855                                860
Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His
865                                870                                875                                880
Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg
885                                890                                895
Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu
900                                905                                910
Gly Met Asp Glu Leu Tyr Lys
915

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## (2) INFORMATION FOR SEQ ID NO:148:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 3009 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

(A) NAME/KEY: Coding Sequence

(B) LOCATION: 1...3006

(D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:148:

ATG GCT CAG CAG ACA AGC CCG GAC ACT TTA ACA GTA CCT GAA GTG GAT	48
Met Ala Gln Gln Thr Ser Pro Asp Thr Leu Thr Val Pro Glu Val Asp	
1 5 10 15	
AAT CCG CAT TGT CCA AAC CCG TGG CTG AAC GAA GAC CTT GTG AAA TCC	96
Asn Pro His Cys Pro Asn Pro Trp Leu Asn Glu Asp Leu Val Lys Ser	
20 25 30	
TTG CGA GAA AAC CTG TTG CAG CAT GAG AAG TCC AAG ACA GCG AGG AAA	144
Leu Arg Glu Asn Leu Leu Gln His Glu Lys Ser Lys Thr Ala Arg Lys	
35 40 45	
TCG GTT TCT CCC AAG CTC TCT CCA GTG ATC TCT CCG AGA AAT TCC CCC	192
Ser Val Ser Pro Lys Leu Ser Pro Val Ile Ser Pro Arg Asn Ser Pro	
50 55 60	
AGG CTT CTG CGC AGA ATG CTT CTC AGC AGC AAC ATC CCC AAA CAG CGG	240
Arg Leu Leu Arg Arg Met Leu Leu Ser Ser Asn Ile Pro Lys Gln Arg	
65 70 75 80	
CGT TTC ACG GTG GCA CAT ACA TGT TTT GAT GTG GAC AAT GGC ACA TCT	288
Arg Phe Thr Val Ala His Thr Cys Phe Asp Val Asp Asn Gly Thr Ser	
85 90 95	
GCG GGA CGG AGT CCC TTG GAT CCC ATG ACC AGC CCA GGA TCC GGG CTA	336
Ala Gly Arg Ser Pro Leu Asp Pro Met Thr Ser Pro Gly Ser Gly Leu	
100 105 110	
ATT CTC CAA GCA AAT TTT GTC CAC AGT CAA CGA CGG GAG TCC TTC CTG	384
Ile Leu Gln Ala Asn Phe Val His Ser Gln Arg Arg Glu Ser Phe Leu	
115 120 125	
TAT CGA TCC GAC AGC GAT TAT GAC CTC TCT CCA AAG TCT ATG TCC CGG	432
Tyr Arg Ser Asp Ser Asp Tyr Asp Leu Ser Pro Lys Ser Met Ser Arg	
130 135 140	
AAC TCC TCC ATT GCC AGT GAT ATA CAC GGA GAT GAC TTG ATT GTG ACT	480
Asn Ser Ser Ile Ala Ser Asp Ile His Gly Asp Asp Leu Ile Val Thr	
145 150 155 160	
CCA TTT GCT CAG GTC TTG GCC AGT CTG CGA ACT GTA CGA AAC AAC TTT	528
Pro Phe Ala Gln Val Leu Ala Ser Leu Arg Thr Val Arg Asn Asn Phe	
165 170 175	
GCT GCA TTA ACT AAT TTG CAA GAT CGA GCA CCT AGC AAA AGA TCA CCC	576
Ala Ala Leu Thr Asn Leu Gln Asp Arg Ala Pro Ser Lys Arg Ser Pro	
180 185 190	

ATG TGC AAC CAA CCA TCC ATC AAC AAA GCC ACC ATA ACA GAG GAG GCC	624
Met Cys Asn Gln Pro Ser Ile Asn Lys Ala Thr Ile Thr Glu Glu Ala	
195 200 205	
TAC CAG AAA CTG GCC AGC GAG ACC CTG GAG GAG CTG GAC TGG TGT CTG	672
Tyr Gln Lys Leu Ala Ser Glu Thr Leu Glu Glu Leu Asp Trp Cys Leu	
210 215 220	
GAC CAG CTA GAG ACC CTA CAG ACC AGG CAC TCC GTC AGT GAG ATG GCC	720
Asp Gln Leu Glu Thr Leu Gln Thr Arg His Ser Val Ser Glu Met Ala	
225 230 235 240	
TCC AAC AAG TTT AAA AGG ATG CTT AAT CGG GAG CTC ACC CAT CTC TCT	768
Ser Asn Lys Phe Lys Arg Met Leu Asn Arg Glu Leu Thr His Leu Ser	
245 250 255	
GAA ATG AGT CGG TCT GGA AAT CAA GTG TCA GAG TTT ATA TCA AAC ACA	816
Glu Met Ser Arg Ser Gly Asn Gln Val Ser Glu Phe Ile Ser Asn Thr	
260 265 270	
TTC TTA GAT AAG CAA CAT GAA GTG GAA ATT CCT TCT CCA ACT CAG AAG	864
Phe Leu Asp Lys Gln His Glu Val Glu Ile Pro Ser Pro Thr Gln Lys	
275 280 285	
GAA AAG GAG AAA AAG AAA AGA CCA ATG TCT CAG ATC AGT GGA GTC AAG	912
Glu Lys Glu Lys Lys Lys Arg Pro Met Ser Gln Ile Ser Gly Val Lys	
290 295 300	
AAA TTG ATG CAC AGC TCT AGT CTG ACT AAT TCA AGT ATC CCA AGG TTT	960
Lys Leu Met His Ser Ser Ser Leu Thr Asn Ser Ser Ile Pro Arg Phe	
305 310 315 320	
GGA GTT AAA ACT GAA CAA GAA GAT GTC CTT GCC AAG GAA CTA GAA GAT	1008
Gly Val Lys Thr Glu Gln Glu Asp Val Leu Ala Lys Glu Leu Glu Asp	
325 330 335	
GTG AAC AAA TGG GGT CTT CAT GTT TTC AGA ATA GCA GAG TTG TCT GGT	1056
Val Asn Lys Trp Gly Leu His Val Phe Arg Ile Ala Glu Leu Ser Gly	
340 345 350	
AAC CGG CCC TTG ACT GTT ATC ATG CAC ACC ATT TTT CAG GAA CGG GAT	1104
Asn Arg Pro Leu Thr Val Ile Met His Thr Ile Phe Gln Glu Arg Asp	
355 360 365	
TTA TTA AAA ACA TTT AAA ATT CCA GTA GAT ACT TTA ATT ACA TAT CTT	1152
Leu Leu Lys Thr Phe Lys Ile Pro Val Asp Thr Leu Ile Thr Tyr Leu	
370 375 380	
ATG ACT CTC GAA GAC CAT TAC CAT GCT GAT GTG GCC TAT CAC AAC AAT	1200
Met Thr Leu Glu Asp His Tyr His Ala Asp Val Ala Tyr His Asn Asn	
385 390 395 400	
ATC CAT GCT GCA GAT GTT GTC CAG TCT ACT CAT GTG CTA TTA TCT ACA	1248
Ile His Ala Ala Asp Val Val Gln Ser Thr His Val Leu Leu Ser Thr	

405	410	415	
CCT GCT TTG GAG GCT GTG TTT ACA GAT TTG GAG ATT CTT GCA GCA ATT			1296
Pro Ala Leu Glu Ala Val Phe Thr Asp Leu Glu Ile Leu Ala Ala Ile			
420	425	430	
TTT GCC AGT GCA ATA CAT GAT GTA GAT CAT CCT GGT GTG TCC AAT CAA			1344
Phe Ala Ser Ala Ile His Asp Val Asp His Pro Gly Val Ser Asn Gln			
435	440	445	
TTT CTG ATC AAT ACA AAC TCT GAA CTT GCC TTG ATG TAC AAT GAT TCC			1392
Phe Leu Ile Asn Thr Asn Ser Glu Leu Ala Leu Met Tyr Asn Asp Ser			
450	455	460	
TCA GTC TTA GAG AAC CAT CAT TTG GCT GTG GGC TTT AAA TTG CTT CAG			1440
Ser Val Leu Glu Asn His His Leu Ala Val Gly Phe Lys Leu Leu Gln			
465	470	475	480
GAA GAA AAC TGT GAC ATT TTC CAG AAT TTG ACC AAA AAA CAA AGA CAA			1488
Glu Glu Asn Cys Asp Ile Phe Gln Asn Leu Thr Lys Lys Gln Arg Gln			
485	490	495	
TCT TTA AGG AAA ATG GTC ATT GAC ATC GTA CTT GCA ACA GAT ATG TCA			1536
Ser Leu Arg Lys Met Val Ile Asp Ile Val Leu Ala Thr Asp Met Ser			
500	505	510	
AAA CAC ATG AAT CTA CTG GCT GAT TTG AAG ACT ATG GTT GAA ACT AAG			1584
Lys His Met Asn Leu Leu Ala Asp Leu Lys Thr Met Val Glu Thr Lys			
515	520	525	
AAA GTG ACA AGC TCT GGA GTT CTT CTT CTT GAT AAT TAT TCC GAT AGG			1632
Lys Val Thr Ser Ser Gly Val Leu Leu Leu Asp Asn Tyr Ser Asp Arg			
530	535	540	
ATT CAG GTT CTT CAG AAT ATG GTG CAC TGT GCA GAT CTG AGC AAC CCA			1680
Ile Gln Val Leu Gln Asn Met Val His Cys Ala Asp Leu Ser Asn Pro			
545	550	555	560
ACA AAG CCT CTC CAG CTG TAC CGC CAG TGG ACG GAC CGG ATA ATG GAG			1728
Thr Lys Pro Leu Gln Leu Tyr Arg Gln Trp Thr Asp Arg Ile Met Glu			
565	570	575	
GAG TTC TTC CGC CAA GGA GAC CGA GAG AGG GAA CGT GGC ATG GAG ATA			1776
Glu Phe Phe Arg Gln Gly Asp Arg Glu Arg Glu Arg Gly Met Glu Ile			
580	585	590	
AGC CCC ATG TGT GAC AAG CAC AAT GCT TCC GTG GAA AAA TCA CAG GTG			1824
Ser Pro Met Cys Asp Lys His Asn Ala Ser Val Glu Lys Ser Gln Val			
595	600	605	
GGC TTC ATA GAC TAT ATT GTT CAT CCC CTC TGG GAG ACA TGG GCA GAC			1872
Gly Phe Ile Asp Tyr Ile Val His Pro Leu Trp Glu Thr Trp Ala Asp			
610	615	620	

CTC	GTC	CAC	CCT	GAC	GCC	CAG	GAT	ATT	TTG	GAC	ACT	TTG	GAG	GAC	AAT	1920
Leu	Val	His	Pro	Asp	Ala	Gln	Asp	Ile	Leu	Asp	Thr	Leu	Glu	Asp	Asn	
625					630					635					640	
CGT	GAA	TGG	TAC	CAG	AGC	ACA	ATC	CCT	CAG	AGC	CCC	TCT	CCT	GCA	CCT	1968
Arg	Glu	Trp	Tyr	Gln	Ser	Thr	Ile	Pro	Gln	Ser	Pro	Ser	Pro	Ala	Pro	
				645					650					655		
GAT	GAC	CCA	GAG	GAG	GGC	CGG	CAG	GGT	CAA	ACT	GAG	AAA	TTC	CAG	TTT	2016
Asp	Asp	Pro	Glu	Glu	Gly	Arg	Gln	Gly	Gln	Thr	Glu	Lys	Phe	Gln	Phe	
			660					665					670			
GAA	CTA	ACT	TTA	GAG	GAA	GAT	GGT	GAG	TCA	GAC	ACG	GAA	AAG	GAC	AGT	2064
Glu	Leu	Thr	Leu	Glu	Glu	Asp	Gly	Glu	Ser	Asp	Thr	Glu	Lys	Asp	Ser	
			675				680						685			
GGC	AGT	CAA	GTG	GAA	GAA	GAC	ACT	AGC	TGC	AGT	GAC	TCC	AAG	ACT	CTT	2112
Gly	Ser	Gln	Val	Glu	Glu	Asp	Thr	Ser	Cys	Ser	Asp	Ser	Lys	Thr	Leu	
	690					695				700						
TGT	ACT	CAA	GAC	TCA	GAG	TCT	ACT	GAA	ATT	CCC	CTT	GAT	GAA	CAG	GTT	2160
Cys	Thr	Gln	Asp	Ser	Glu	Ser	Thr	Glu	Ile	Pro	Leu	Asp	Glu	Gln	Val	
705					710					715				720		
GAA	GAG	GAG	GCA	GTA	GGG	GAA	GAA	GAG	GAA	AGC	CAG	CCT	GAA	GCC	TGT	2208
Glu	Glu	Glu	Ala	Val	Gly	Glu	Glu	Glu	Glu	Ser	Gln	Pro	Glu	Ala	Cys	
				725				730						735		
GTC	ATA	GAT	GAT	CGT	TCT	CCT	GAC	ACG	ACG	GGA	ATT	CTG	CAG	TCG	ACG	2256
Val	Ile	Asp	Asp	Arg	Ser	Pro	Asp	Thr	Thr	Gly	Ile	Leu	Gln	Ser	Thr	
				740				745					750			
GTA	CCG	CGG	GCC	CGG	GAT	CCA	CCG	GTC	GCC	ACC	ATG	GTG	AGC	AAG	GGC	2304
Val	Pro	Arg	Ala	Arg	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly	
			755				760					765				
GAG	GAG	CTG	TTC	ACC	GGG	GTG	GTG	CCC	ATC	CTG	GTC	GAG	CTG	GAC	GGC	2352
Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly	
	770					775				780						
GAC	GTA	AAC	GGC	CAC	AAG	TTC	AGC	GTG	TCC	GGC	GAG	GGC	GAG	GGC	GAT	2400
Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp	
785					790					795					800	
GCC	ACC	TAC	GGC	AAG	CTG	ACC	CTG	AAG	TTC	ATC	TGC	ACC	ACC	GGC	AAG	2448
Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys	
				805					810					815		
CTG	CCC	GTG	CCC	TGG	CCC	ACC	CTC	GTG	ACC	ACC	CTG	ACC	TAC	GGC	GTG	2496
Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val	
			820					825					830			
CAG	TGC	TTC	AGC	CGC	TAC	CCC	GAC	CAC	ATG	AAG	CAG	CAC	GAC	TTC	TTC	2544
Gln	Cys	Phe	Ser	Arg	Tyr	Pro	Asp	His	Met	Lys	Gln	His	Asp	Phe	Phe	

835	840	845	
AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC			2592
Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe			
850	855	860	
AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC			2640
Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly			
865	870	875	880
GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG			2688
Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu			
885	890	895	
GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC			2736
Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His			
900	905	910	
AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC			2784
Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn			
915	920	925	
TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC			2832
Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp			
930	935	940	
CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC			2880
His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro			
945	950	955	960
GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC			2928
Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn			
965	970	975	
GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG			2976
Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly			
980	985	990	
ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA			3009
Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys			
995	1000		

## (2) INFORMATION FOR SEQ ID NO:149:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1002 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal



## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:149:

```

Met Ala Gln Gln Thr Ser Pro Asp Thr Leu Thr Val Pro Glu Val Asp
 1           5           10           15
Asn Pro His Cys Pro Asn Pro Trp Leu Asn Glu Asp Leu Val Lys Ser
          20           25           30
Leu Arg Glu Asn Leu Leu Gln His Glu Lys Ser Lys Thr Ala Arg Lys
          35           40           45
Ser Val Ser Pro Lys Leu Ser Pro Val Ile Ser Pro Arg Asn Ser Pro
          50           55           60
Arg Leu Leu Arg Arg Met Leu Leu Ser Ser Asn Ile Pro Lys Gln Arg
          65           70           75           80
Arg Phe Thr Val Ala His Thr Cys Phe Asp Val Asp Asn Gly Thr Ser
          85           90           95
Ala Gly Arg Ser Pro Leu Asp Pro Met Thr Ser Pro Gly Ser Gly Leu
          100          105          110
Ile Leu Gln Ala Asn Phe Val His Ser Gln Arg Arg Glu Ser Phe Leu
          115          120          125
Tyr Arg Ser Asp Ser Asp Tyr Asp Leu Ser Pro Lys Ser Met Ser Arg
          130          135          140
Asn Ser Ser Ile Ala Ser Asp Ile His Gly Asp Asp Leu Ile Val Thr
          145          150          155          160
Pro Phe Ala Gln Val Leu Ala Ser Leu Arg Thr Val Arg Asn Asn Phe
          165          170          175
Ala Ala Leu Thr Asn Leu Gln Asp Arg Ala Pro Ser Lys Arg Ser Pro
          180          185          190
Met Cys Asn Gln Pro Ser Ile Asn Lys Ala Thr Ile Thr Glu Glu Ala
          195          200          205
Tyr Gln Lys Leu Ala Ser Glu Thr Leu Glu Glu Leu Asp Trp Cys Leu
          210          215          220
Asp Gln Leu Glu Thr Leu Gln Thr Arg His Ser Val Ser Glu Met Ala
          225          230          235          240
Ser Asn Lys Phe Lys Arg Met Leu Asn Arg Glu Leu Thr His Leu Ser
          245          250          255
Glu Met Ser Arg Ser Gly Asn Gln Val Ser Glu Phe Ile Ser Asn Thr
          260          265          270
Phe Leu Asp Lys Gln His Glu Val Glu Ile Pro Ser Pro Thr Gln Lys
          275          280          285
Glu Lys Glu Lys Lys Lys Arg Pro Met Ser Gln Ile Ser Gly Val Lys
          290          295          300
Lys Leu Met His Ser Ser Ser Leu Thr Asn Ser Ser Ile Pro Arg Phe
          305          310          315          320
Gly Val Lys Thr Glu Gln Glu Asp Val Leu Ala Lys Glu Leu Glu Asp
          325          330          335
Val Asn Lys Trp Gly Leu His Val Phe Arg Ile Ala Glu Leu Ser Gly
          340          345          350
Asn Arg Pro Leu Thr Val Ile Met His Thr Ile Phe Gln Glu Arg Asp
          355          360          365
Leu Leu Lys Thr Phe Lys Ile Pro Val Asp Thr Leu Ile Thr Tyr Leu
          370          375          380
Met Thr Leu Glu Asp His Tyr His Ala Asp Val Ala Tyr His Asn Asn
          385          390          395          400
Ile His Ala Ala Asp Val Val Gln Ser Thr His Val Leu Leu Ser Thr
          405          410          415

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Pro Ala Leu Glu Ala Val Phe Thr Asp Leu Glu Ile Leu Ala Ala Ile  
 420 425 430  
 Phe Ala Ser Ala Ile His Asp Val Asp His Pro Gly Val Ser Asn Gln  
 435 440 445  
 Phe Leu Ile Asn Thr Asn Ser Glu Leu Ala Leu Met Tyr Asn Asp Ser  
 450 455 460  
 Ser Val Leu Glu Asn His His Leu Ala Val Gly Phe Lys Leu Leu Gln  
 465 470 475 480  
 Glu Glu Asn Cys Asp Ile Phe Gln Asn Leu Thr Lys Lys Gln Arg Gln  
 485 490 495  
 Ser Leu Arg Lys Met Val Ile Asp Ile Val Leu Ala Thr Asp Met Ser  
 500 505 510  
 Lys His Met Asn Leu Leu Ala Asp Leu Lys Thr Met Val Glu Thr Lys  
 515 520 525  
 Lys Val Thr Ser Ser Gly Val Leu Leu Leu Asp Asn Tyr Ser Asp Arg  
 530 535 540  
 Ile Gln Val Leu Gln Asn Met Val His Cys Ala Asp Leu Ser Asn Pro  
 545 550 555 560  
 Thr Lys Pro Leu Gln Leu Tyr Arg Gln Trp Thr Asp Arg Ile Met Glu  
 565 570 575  
 Glu Phe Phe Arg Gln Gly Asp Arg Glu Arg Glu Arg Gly Met Glu Ile  
 580 585 590  
 Ser Pro Met Cys Asp Lys His Asn Ala Ser Val Glu Lys Ser Gln Val  
 595 600 605  
 Gly Phe Ile Asp Tyr Ile Val His Pro Leu Trp Glu Thr Trp Ala Asp  
 610 615 620  
 Leu Val His Pro Asp Ala Gln Asp Ile Leu Asp Thr Leu Glu Asp Asn  
 625 630 635 640  
 Arg Glu Trp Tyr Gln Ser Thr Ile Pro Gln Ser Pro Ser Pro Ala Pro  
 645 650 655  
 Asp Asp Pro Glu Glu Gly Arg Gln Gly Gln Thr Glu Lys Phe Gln Phe  
 660 665 670  
 Glu Leu Thr Leu Glu Glu Asp Gly Glu Ser Asp Thr Glu Lys Asp Ser  
 675 680 685  
 Gly Ser Gln Val Glu Glu Asp Thr Ser Cys Ser Asp Ser Lys Thr Leu  
 690 695 700  
 Cys Thr Gln Asp Ser Glu Ser Thr Glu Ile Pro Leu Asp Glu Gln Val  
 705 710 715 720  
 Glu Glu Glu Ala Val Gly Glu Glu Glu Glu Ser Gln Pro Glu Ala Cys  
 725 730 735  
 Val Ile Asp Asp Arg Ser Pro Asp Thr Thr Gly Ile Leu Gln Ser Thr  
 740 745 750  
 Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly  
 755 760 765  
 Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly  
 770 775 780  
 Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp  
 785 790 795 800  
 Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys  
 805 810 815  
 Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val  
 820 825 830  
 Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe  
 835 840 845

Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe  
 850 855 860  
 Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly  
 865 870 875 880  
 Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu  
 885 890 895  
 Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His  
 900 905 910  
 Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn  
 915 920 925  
 Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp  
 930 935 940  
 His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro  
 945 950 955 960  
 Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn  
 965 970 975  
 Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly  
 980 985 990  
 Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys  
 995 1000

(2) INFORMATION FOR SEQ ID NO:150:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 3201 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

(ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...3198
- (D) OTHER INFORMATION:

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:150:

ATG GAG GCA GAG GGC AGC AGC GCG CCG GCC CGG GCG GGC AGC GGA GAG	48
Met Glu Ala Glu Gly Ser Ser Ala Pro Ala Arg Ala Gly Ser Gly Glu	
1 5 10 15	
GGC AGC GAC AGC GCC GGC GGG GCC ACG CTC AAA GCC CCC AAG CAT CTC	96
Gly Ser Asp Ser Ala Gly Gly Ala Thr Leu Lys Ala Pro Lys His Leu	
20 25 30	
TGG AGG CAC GAG CAG CAC CAC CAG TAC CCG CTC CGG CAG CCC CAG TTC	144
Trp Arg His Glu Gln His His Gln Tyr Pro Leu Arg Gln Pro Gln Phe	
35 40 45	
CGC CTC CTG CAT CCC CAT CAC CAC CTG CCC CCG CCG CCG CCA CCC TCG	192
Arg Leu Leu His Pro His His Leu Pro Pro Pro Pro Pro Ser	
50 55 60	

CCC CAG CCC CAG CCC CAG TGT CCG CTA CAG CCG CCG CCG CCG CCC CCC	240
Pro Gln Pro Gln Pro Gln Cys Pro Leu Gln Pro Pro Pro Pro Pro Pro	
65 70 75 80	
CTG CCG CCG CCC CCG CCG CCG CCC GGG GCT GCC CGC GGC CGC TAC GCC	288
Leu Pro Pro Pro Pro Pro Pro Pro Gly Ala Ala Arg Gly Arg Tyr Ala	
85 90 95	
TCG AGC GGG GCC ACC GGC CGC GTC CCG CAT CGC GGC TAC TCG GAC ACC	336
Ser Ser Gly Ala Thr Gly Arg Val Arg His Arg Gly Tyr Ser Asp Thr	
100 105 110	
GAG CGC TAC CTG TAC TGT CGC GCC ATG GAC CGC ACC TCC TAC GCG GTG	384
Glu Arg Tyr Leu Tyr Cys Arg Ala Met Asp Arg Thr Ser Tyr Ala Val	
115 120 125	
GAG ACC GGC CAC CGG CCC GGC CTG AAG AAA TCC AGG ATG TCC TGG CCC	432
Glu Thr Gly His Arg Pro Gly Leu Lys Lys Ser Arg Met Ser Trp Pro	
130 135 140	
TCC TCG TTC CAG GGA CTC AGG CGT TTT GAT GTG GAC AAT GGC ACA TCT	480
Ser Ser Phe Gln Gly Leu Arg Arg Phe Asp Val Asp Asn Gly Thr Ser	
145 150 155 160	
GCG GGA CGG AGT CCC TTG GAT CCC ATG ACC AGC CCA GGA TCC GGG CTA	528
Ala Gly Arg Ser Pro Leu Asp Pro Met Thr Ser Pro Gly Ser Gly Leu	
165 170 175	
ATT CTC CAA GCA AAT TTT GTC CAC AGT CAA CGA CGG GAG TCC TTC CTG	576
Ile Leu Gln Ala Asn Phe Val His Ser Gln Arg Arg Glu Ser Phe Leu	
180 185 190	
TAT CGA TCC GAC AGC GAT TAT GAC CTC TCT CCA AAG TCT ATG TCC CGG	624
Tyr Arg Ser Asp Ser Asp Tyr Asp Leu Ser Pro Lys Ser Met Ser Arg	
195 200 205	
AAC TCC TCC ATT GCC AGT GAT ATA CAC GGA GAT GAC TTG ATT GTG ACT	672
Asn Ser Ser Ile Ala Ser Asp Ile His Gly Asp Asp Leu Ile Val Thr	
210 215 220	
CCA TTT GCT CAG GTC TTG GCC AGT CTG CGA ACT GTA CGA AAC AAC TTT	720
Pro Phe Ala Gln Val Leu Ala Ser Leu Arg Thr Val Arg Asn Asn Phe	
225 230 235 240	
GCT GCA TTA ACT AAT TTG CAA GAT CGA GCA CCT AGC AAA AGA TCA CCC	768
Ala Ala Leu Thr Asn Leu Gln Asp Arg Ala Pro Ser Lys Arg Ser Pro	
245 250 255	
ATG TGC AAC CAA CCA TCC ATC AAC AAA GCC ACC ATA ACA GAG GAG GCC	816
Met Cys Asn Gln Pro Ser Ile Asn Lys Ala Thr Ile Thr Glu Glu Ala	
260 265 270	
TAC CAG AAA CTG GCC AGC GAG ACC CTG GAG GAG CTG GAC TGG TGT CTG	864
Tyr Gln Lys Leu Ala Ser Glu Thr Leu Glu Glu Leu Asp Trp Cys Leu	

275	280	285	
GAC CAG CTA GAG ACC CTA CAG ACC AGG CAC TCC GTC AGT GAG ATG GCC Asp Gln Leu Glu Thr Leu Gln Thr Arg His Ser Val Ser Glu Met Ala 290 295 300			912
TCC AAC AAG TTT AAA AGG ATG CTT AAT CGG GAG CTC ACC CAT CTC TCT Ser Asn Lys Phe Lys Arg Met Leu Asn Arg Glu Leu Thr His Leu Ser 305 310 315 320			960
GAA ATG AGT CGG TCT GGA AAT CAA GTG TCA GAG TTT ATA TCA AAC ACA Glu Met Ser Arg Ser Gly Asn Gln Val Ser Glu Phe Ile Ser Asn Thr 325 330 335			1008
TTC TTA GAT AAG CAA CAT GAA GTG GAA ATT CCT TCT CCA ACT CAG AAG Phe Leu Asp Lys Gln His Glu Val Glu Ile Pro Ser Pro Thr Gln Lys 340 345 350			1056
GAA AAG GAG AAA AAG AAA AGA CCA ATG TCT CAG ATC AGT GGA GTC AAG Glu Lys Glu Lys Lys Lys Arg Pro Met Ser Gln Ile Ser Gly Val Lys 355 360 365			1104
AAA TTG ATG CAC AGC TCT AGT CTG ACT AAT TCA AGT ATC CCA AGG TTT Lys Leu Met His Ser Ser Ser Leu Thr Asn Ser Ser Ile Pro Arg Phe 370 375 380			1152
GGA GTT AAA ACT GAA CAA GAA GAT GTC CTT GCC AAG GAA CTA GAA GAT Gly Val Lys Thr Glu Gln Glu Asp Val Leu Ala Lys Glu Leu Glu Asp 385 390 395 400			1200
GTG AAC AAA TGG GGT CTT CAT GTT TTC AGA ATA GCA GAG TTG TCT GGT Val Asn Lys Trp Gly Leu His Val Phe Arg Ile Ala Glu Leu Ser Gly 405 410 415			1248
AAC CGG CCC TTG ACT GTT ATC ATG CAC ACC ATT TTT CAG GAA CGG GAT Asn Arg Pro Leu Thr Val Ile Met His Thr Ile Phe Gln Glu Arg Asp 420 425 430			1296
TTA TTA AAA ACA TTT AAA ATT CCA GTA GAT ACT TTA ATT ACA TAT CTT Leu Leu Lys Thr Phe Lys Ile Pro Val Asp Thr Leu Ile Thr Tyr Leu 435 440 445			1344
ATG ACT CTC GAA GAC CAT TAC CAT GCT GAT GTG GCC TAT CAC AAC AAT Met Thr Leu Glu Asp His Tyr His Ala Asp Val Ala Tyr His Asn Asn 450 455 460			1392
ATC CAT GCT GCA GAT GTT GTC CAG TCT ACT CAT GTG CTA TTA TCT ACA Ile His Ala Ala Asp Val Val Gln Ser Thr His Val Leu Leu Ser Thr 465 470 475 480			1440
CCT GCT TTG GAG GCT GTG TTT ACA GAT TTG GAG ATT CTT GCA GCA ATT Pro Ala Leu Glu Ala Val Phe Thr Asp Leu Glu Ile Leu Ala Ala Ile 485 490 495			1488

TTT GCC AGT GCA ATA CAT GAT GTA GAT CAT CCT GGT GTG TCC AAT CAA	1536
Phe Ala Ser Ala Ile His Asp Val Asp His Pro Gly Val Ser Asn Gln	
500 505 510	
TTT CTG ATC AAT ACA AAC TCT GAA CTT GCC TTG ATG TAC AAT GAT TCC	1584
Phe Leu Ile Asn Thr Asn Ser Glu Leu Ala Leu Met Tyr Asn Asp Ser	
515 520 525	
TCA GTC TTA GAG AAC CAT CAT TTG GCT GTG GGC TTT AAA TTG CTT CAG	1632
Ser Val Leu Glu Asn His His Leu Ala Val Gly Phe Lys Leu Leu Gln	
530 535 540	
GAA GAA AAC TGT GAC ATT TTC CAG AAT TTG ACC AAA AAA CAA AGA CAA	1680
Glu Glu Asn Cys Asp Ile Phe Gln Asn Leu Thr Lys Lys Gln Arg Gln	
545 550 555 560	
TCT TTA AGG AAA ATG GTC ATT GAC ATC GTA CTT GCA ACA GAT ATG TCA	1728
Ser Leu Arg Lys Met Val Ile Asp Ile Val Leu Ala Thr Asp Met Ser	
565 570 575	
AAA CAC ATG AAT CTA CTG GCT GAT TTG AAG ACT ATG GTT GAA ACT AAG	1776
Lys His Met Asn Leu Leu Ala Asp Leu Lys Thr Met Val Glu Thr Lys	
580 585 590	
AAA GTG ACA AGC TCT GGA GTT CTT CTT CTT GAT AAT TAT TCC GAT AGG	1824
Lys Val Thr Ser Ser Gly Val Leu Leu Asp Asn Tyr Ser Asp Arg	
595 600 605	
ATT CAG GTT CTT CAG AAT ATG GTG CAC TGT GCA GAT CTG AGC AAC CCA	1872
Ile Gln Val Leu Gln Asn Met Val His Cys Ala Asp Leu Ser Asn Pro	
610 615 620	
ACA AAG CCT CTC CAG CTG TAC CGC CAG TGG ACG GAC CGG ATA ATG GAG	1920
Thr Lys Pro Leu Gln Leu Tyr Arg Gln Trp Thr Asp Arg Ile Met Glu	
625 630 635 640	
GAG TTC TTC CGC CAA GGA GAC CGA GAG AGG GAA CGT GGC ATG GAG ATA	1968
Glu Phe Phe Arg Gln Gly Asp Arg Glu Arg Glu Arg Gly Met Glu Ile	
645 650 655	
AGC CCC ATG TGT GAC AAG CAC AAT GCT TCC GTG GAA AAA TCA CAG GTG	2016
Ser Pro Met Cys Asp Lys His Asn Ala Ser Val Glu Lys Ser Gln Val	
660 665 670	
GGC TTC ATA GAC TAT ATT GTT CAT CCC CTC TGG GAG ACA TGG GCA GAC	2064
Gly Phe Ile Asp Tyr Ile Val His Pro Leu Trp Glu Thr Trp Ala Asp	
675 680 685	
CTC GTC CAC CCT GAC GCC CAG GAT ATT TTG GAC ACT TTG GAG GAC AAT	2112
Leu Val His Pro Asp Ala Gln Asp Ile Leu Asp Thr Leu Glu Asp Asn	
690 695 700	
CGT GAA TGG TAC CAG AGC ACA ATC CCT CAG AGC CCC TCT CCT GCA CCT	2160
Arg Glu Trp Tyr Gln Ser Thr Ile Pro Gln Ser Pro Ser Pro Ala Pro	

705	710	715	720	
GAT GAC CCA GAG GAG GGC CGG CAG GGT CAA ACT GAG AAA TTC CAG TTT				2208
Asp Asp Pro Glu Glu Gly Arg Gln Gly Gln Thr Glu Lys Phe Gln Phe				
725		730	735	
GAA CTA ACT TTA GAG GAA GAT GGT GAG TCA GAC ACG GAA AAG GAC AGT				2256
Glu Leu Thr Leu Glu Glu Asp Gly Glu Ser Asp Thr Glu Lys Asp Ser				
740		745	750	
GGC AGT CAA GTG GAA GAA GAC ACT AGC TGC AGT GAC TCC AAG ACT CTT				2304
Gly Ser Gln Val Glu Glu Asp Thr Ser Cys Ser Asp Ser Lys Thr Leu				
755		760	765	
TGT ACT CAA GAC TCA GAG TCT ACT GAA ATT CCC CTT GAT GAA CAG GTT				2352
Cys Thr Gln Asp Ser Glu Ser Thr Glu Ile Pro Leu Asp Glu Gln Val				
770		775	780	
GAA GAG GAG GCA GTA GGG GAA GAA GAG GAA AGC CAG CCT GAA GCC TGT				2400
Glu Glu Glu Ala Val Gly Glu Glu Glu Glu Ser Gln Pro Glu Ala Cys				
785		790	795	800
GTC ATA GAT GAT CGT TCT CCT GAC ACG ACG GGA ATT CTG CAG TCG ACG				2448
Val Ile Asp Asp Arg Ser Pro Asp Thr Thr Gly Ile Leu Gln Ser Thr				
805		810	815	
GTA CCG CGG GCC CGG GAT CCA CCG GTC GCC ACC ATG GTG AGC AAG GGC				2496
Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr Met Val Ser Lys Gly				
820		825	830	
GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG GTC GAG CTG GAC GGC				2544
Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu Val Glu Leu Asp Gly				
835		840	845	
GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC GAG GGC GAG GGC GAT				2592
Asp Val Asn Gly His Lys Phe Ser Val Ser Gly Glu Gly Glu Gly Asp				
850		855	860	
GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC TGC ACC ACC GGC AAG				2640
Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile Cys Thr Thr Gly Lys				
865		870	875	880
CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC CTG ACC TAC GGC GTG				2688
Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr Leu Thr Tyr Gly Val				
885		890	895	
CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG CAG CAC GAC TTC TTC				2736
Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe				
900		905	910	
AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG CGC ACC ATC TTC TTC				2784
Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe				
915		920	925	

AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG GTG AAG TTC GAG GGC	2832
Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly	
930 935 940	
GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC ATC GAC TTC AAG GAG	2880
Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu	
945 950 955 960	
GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC AAC TAC AAC AGC CAC	2928
Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His	
965 970 975	
AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC GGC ATC AAG GTG AAC	2976
Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn	
980 985 990	
TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC GTG CAG CTC GCC GAC	3024
Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp	
995 1000 1005	
CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC CCC GTG CTG CTG CCC	3072
His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro	
1010 1015 1020	
GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG AGC AAA GAC CCC AAC	3120
Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn	
1025 1030 1035 1040	
GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC GTG ACC GCC GCC GGG	3168
Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly	
1045 1050 1055	
ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA	3201
Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys	
1060 1065	

## (2) INFORMATION FOR SEQ ID NO:151:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1066 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:151:

Met Glu Ala Glu Gly Ser Ser Ala Pro Ala Arg Ala Gly Ser Gly Glu
1 5 10 15
Gly Ser Asp Ser Ala Gly Gly Ala Thr Leu Lys Ala Pro Lys His Leu
20 25 30



Trp Arg His Glu Gln His His Gln Tyr Pro Leu Arg Gln Pro Gln Phe  
 35 40 45  
 Arg Leu Leu His Pro His His His Leu Pro Pro Pro Pro Pro Ser  
 50 55 60  
 Pro Gln Pro Gln Pro Gln Cys Pro Leu Gln Pro Pro Pro Pro Pro  
 65 70 75 80  
 Leu Pro Pro Pro Pro Pro Pro Pro Gly Ala Ala Arg Gly Arg Tyr Ala  
 85 90 95  
 Ser Ser Gly Ala Thr Gly Arg Val Arg His Arg Gly Tyr Ser Asp Thr  
 100 105 110  
 Glu Arg Tyr Leu Tyr Cys Arg Ala Met Asp Arg Thr Ser Tyr Ala Val  
 115 120 125  
 Glu Thr Gly His Arg Pro Gly Leu Lys Lys Ser Arg Met Ser Trp Pro  
 130 135 140  
 Ser Ser Phe Gln Gly Leu Arg Arg Phe Asp Val Asp Asn Gly Thr Ser  
 145 150 155 160  
 Ala Gly Arg Ser Pro Leu Asp Pro Met Thr Ser Pro Gly Ser Gly Leu  
 165 170 175  
 Ile Leu Gln Ala Asn Phe Val His Ser Gln Arg Arg Glu Ser Phe Leu  
 180 185 190  
 Tyr Arg Ser Asp Ser Asp Tyr Asp Leu Ser Pro Lys Ser Met Ser Arg  
 195 200 205  
 Asn Ser Ser Ile Ala Ser Asp Ile His Gly Asp Asp Leu Ile Val Thr  
 210 215 220  
 Pro Phe Ala Gln Val Leu Ala Ser Leu Arg Thr Val Arg Asn Asn Phe  
 225 230 235 240  
 Ala Ala Leu Thr Asn Leu Gln Asp Arg Ala Pro Ser Lys Arg Ser Pro  
 245 250 255  
 Met Cys Asn Gln Pro Ser Ile Asn Lys Ala Thr Ile Thr Glu Glu Ala  
 260 265 270  
 Tyr Gln Lys Leu Ala Ser Glu Thr Leu Glu Glu Leu Asp Trp Cys Leu  
 275 280 285  
 Asp Gln Leu Glu Thr Leu Gln Thr Arg His Ser Val Ser Glu Met Ala  
 290 295 300  
 Ser Asn Lys Phe Lys Arg Met Leu Asn Arg Glu Leu Thr His Leu Ser  
 305 310 315 320  
 Glu Met Ser Arg Ser Gly Asn Gln Val Ser Glu Phe Ile Ser Asn Thr  
 325 330 335  
 Phe Leu Asp Lys Gln His Glu Val Glu Ile Pro Ser Pro Thr Gln Lys  
 340 345 350  
 Glu Lys Glu Lys Lys Lys Arg Pro Met Ser Gln Ile Ser Gly Val Lys  
 355 360 365  
 Lys Leu Met His Ser Ser Ser Leu Thr Asn Ser Ser Ile Pro Arg Phe  
 370 375 380  
 Gly Val Lys Thr Glu Gln Glu Asp Val Leu Ala Lys Glu Leu Glu Asp  
 385 390 395 400  
 Val Asn Lys Trp Gly Leu His Val Phe Arg Ile Ala Glu Leu Ser Gly  
 405 410 415  
 Asn Arg Pro Leu Thr Val Ile Met His Thr Ile Phe Gln Glu Arg Asp  
 420 425 430  
 Leu Leu Lys Thr Phe Lys Ile Pro Val Asp Thr Leu Ile Thr Tyr Leu  
 435 440 445  
 Met Thr Leu Glu Asp His Tyr His Ala Asp Val Ala Tyr His Asn Asn  
 450 455 460

Ile	His	Ala	Ala	Asp	Val	Val	Gln	Ser	Thr	His	Val	Leu	Leu	Ser	Thr	465	470	475	480
Pro	Ala	Leu	Glu	Ala	Val	Phe	Thr	Asp	Leu	Glu	Ile	Leu	Ala	Ala	Ile				
				485					490					495					
Phe	Ala	Ser	Ala	Ile	His	Asp	Val	Asp	His	Pro	Gly	Val	Ser	Asn	Gln				
			500					505					510						
Phe	Leu	Ile	Asn	Thr	Asn	Ser	Glu	Leu	Ala	Leu	Met	Tyr	Asn	Asp	Ser				
			515				520					525							
Ser	Val	Leu	Glu	Asn	His	His	Leu	Ala	Val	Gly	Phe	Lys	Leu	Leu	Gln				
			530				535				540								
Glu	Glu	Asn	Cys	Asp	Ile	Phe	Gln	Asn	Leu	Thr	Lys	Lys	Gln	Arg	Gln				
545					550					555					560				
Ser	Leu	Arg	Lys	Met	Val	Ile	Asp	Ile	Val	Leu	Ala	Thr	Asp	Met	Ser				
				565					570						575				
Lys	His	Met	Asn	Leu	Leu	Ala	Asp	Leu	Lys	Thr	Met	Val	Glu	Thr	Lys				
			580					585					590						
Lys	Val	Thr	Ser	Ser	Gly	Val	Leu	Leu	Leu	Asp	Asn	Tyr	Ser	Asp	Arg				
			595				600					605							
Ile	Gln	Val	Leu	Gln	Asn	Met	Val	His	Cys	Ala	Asp	Leu	Ser	Asn	Pro				
610					615						620								
Thr	Lys	Pro	Leu	Gln	Leu	Tyr	Arg	Gln	Trp	Thr	Asp	Arg	Ile	Met	Glu				
625					630					635					640				
Glu	Phe	Phe	Arg	Gln	Gly	Asp	Arg	Glu	Arg	Glu	Arg	Gly	Met	Glu	Ile				
				645					650					655					
Ser	Pro	Met	Cys	Asp	Lys	His	Asn	Ala	Ser	Val	Glu	Lys	Ser	Gln	Val				
			660					665					670						
Gly	Phe	Ile	Asp	Tyr	Ile	Val	His	Pro	Leu	Trp	Glu	Thr	Trp	Ala	Asp				
			675				680					685							
Leu	Val	His	Pro	Asp	Ala	Gln	Asp	Ile	Leu	Asp	Thr	Leu	Glu	Asp	Asn				
690						695					700								
Arg	Glu	Trp	Tyr	Gln	Ser	Thr	Ile	Pro	Gln	Ser	Pro	Ser	Pro	Ala	Pro				
705					710					715					720				
Asp	Asp	Pro	Glu	Glu	Gly	Arg	Gln	Gly	Gln	Thr	Glu	Lys	Phe	Gln	Phe				
				725					730					735					
Glu	Leu	Thr	Leu	Glu	Glu	Asp	Gly	Glu	Ser	Asp	Thr	Glu	Lys	Asp	Ser				
			740					745					750						
Gly	Ser	Gln	Val	Glu	Glu	Asp	Thr	Ser	Cys	Ser	Asp	Ser	Lys	Thr	Leu				
			755				760					765							
Cys	Thr	Gln	Asp	Ser	Glu	Ser	Thr	Glu	Ile	Pro	Leu	Asp	Glu	Gln	Val				
			770				775					780							
Glu	Glu	Glu	Ala	Val	Gly	Glu	Glu	Glu	Glu	Ser	Gln	Pro	Glu	Ala	Cys				
785					790					795					800				
Val	Ile	Asp	Asp	Arg	Ser	Pro	Asp	Thr	Thr	Gly	Ile	Leu	Gln	Ser	Thr				
				805					810					815					
Val	Pro	Arg	Ala	Arg	Asp	Pro	Pro	Val	Ala	Thr	Met	Val	Ser	Lys	Gly				
			820					825					830						
Glu	Glu	Leu	Phe	Thr	Gly	Val	Val	Pro	Ile	Leu	Val	Glu	Leu	Asp	Gly				
			835				840					845							
Asp	Val	Asn	Gly	His	Lys	Phe	Ser	Val	Ser	Gly	Glu	Gly	Glu	Gly	Asp				
			850			855				860									
Ala	Thr	Tyr	Gly	Lys	Leu	Thr	Leu	Lys	Phe	Ile	Cys	Thr	Thr	Gly	Lys				
865					870					875					880				
Leu	Pro	Val	Pro	Trp	Pro	Thr	Leu	Val	Thr	Thr	Leu	Thr	Tyr	Gly	Val				
				885					890					895					

Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys Gln His Asp Phe Phe  
 900 905 910  
 Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu Arg Thr Ile Phe Phe  
 915 920 925  
 Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu Val Lys Phe Glu Gly  
 930 935 940  
 Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly Ile Asp Phe Lys Glu  
 945 950 955 960  
 Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr Asn Tyr Asn Ser His  
 965 970 975  
 Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn Gly Ile Lys Val Asn  
 980 985 990  
 Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser Val Gln Leu Ala Asp  
 995 1000 1005  
 His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly Pro Val Leu Leu Pro  
 1010 1015 1020  
 Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu Ser Lys Asp Pro Asn  
 025 1030 1035 1040  
 Glu Lys Arg Asp His Met Val Leu Leu Glu Phe Val Thr Ala Ala Gly  
 1045 1050 1055  
 Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys  
 1060 1065

## (2) INFORMATION FOR SEQ ID NO:152:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 3024 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...3021
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:152:

ATG AGC TGG TCA CCT TCC CTG ACA ACG CAG ACA TGT GGG GCC TGG GAA	48
Met Ser Trp Ser Pro Ser Leu Thr Thr Gln Thr Cys Gly Ala Trp Glu	
1 5 10 15	
ATG AAA GAG CGC CTT GGG ACA GGG GGA TTT GGA AAT GTC ATC CGA TGG	96
Met Lys Glu Arg Leu Gly Thr Gly Gly Phe Gly Asn Val Ile Arg Trp	
20 25 30	
CAC AAT CAG GAA ACA GGT GAG CAG ATT GCC ATC AAG CAG TGC CGG CAG	144
His Asn Gln Glu Thr Gly Glu Gln Ile Ala Ile Lys Gln Cys Arg Gln	
35 40 45	
GAG CTC AGC CCC CGG AAC CGA GAG CGG TGG TGC CTG GAG ATC CAG ATC	192
Glu Leu Ser Pro Arg Asn Arg Glu Arg Trp Cys Leu Glu Ile Gln Ile	

50	55	60	
ATG AGA AGG CTG ACC CAC CCC AAT GTG GTG GCT GCC CGA GAT GTC CCT			240
Met Arg Arg Leu Thr His Pro Asn Val Val Ala Ala Arg Asp Val Pro			
65	70	75	80
GAG GGG ATG CAG AAC TTG GCG CCC AAT GAC CTG CCC CTG CTG GCC ATG			288
Glu Gly Met Gln Asn Leu Ala Pro Asn Asp Leu Pro Leu Leu Ala Met			
	85	90	95
GAG TAC TGC CAA GGA GGA GAT CTC CGG AAG TAC CTG AAC CAG TTT GAG			336
Glu Tyr Cys Gln Gly Gly Asp Leu Arg Lys Tyr Leu Asn Gln Phe Glu			
	100	105	110
AAC TGC TGT GGT CTG CGG GAA GGT GCC ATC CTC ACC TTG CTG AGT GAC			384
Asn Cys Cys Gly Leu Arg Glu Gly Ala Ile Leu Thr Leu Leu Ser Asp			
	115	120	125
ATT GCC TCT GCG CTT AGA TAC CTT CAT GAA AAC AGA ATC ATC CAT CGG			432
Ile Ala Ser Ala Leu Arg Tyr Leu His Glu Asn Arg Ile Ile His Arg			
	130	135	140
GAT CTA AAG CCA GAA AAC ATC GTC CTG CAG CAA GGA GAA CAG AGG TTA			480
Asp Leu Lys Pro Glu Asn Ile Val Leu Gln Gln Gly Glu Gln Arg Leu			
145	150	155	160
ATA CAC AAA ATT ATT GAC CTA GGA TAT GCC AAG GAG CTG GAT CAG GGC			528
Ile His Lys Ile Ile Asp Leu Gly Tyr Ala Lys Glu Leu Asp Gln Gly			
	165	170	175
AGT CTT TGC ACA TCA TTC GTG GGG ACC CTG CAG TAC CTG GCC CCA GAG			576
Ser Leu Cys Thr Ser Phe Val Gly Thr Leu Gln Tyr Leu Ala Pro Glu			
	180	185	190
CTA CTG GAG CAG CAG AAG TAC ACA GTG ACC GTC GAC TAC TGG AGC TTC			624
Leu Leu Glu Gln Gln Lys Tyr Thr Val Thr Val Asp Tyr Trp Ser Phe			
	195	200	205
GGC ACC CTG GCC TTT GAG TGC ATC ACG GGC TTC CGG CCC TTC CTC CCC			672
Gly Thr Leu Ala Phe Glu Cys Ile Thr Gly Phe Arg Pro Phe Leu Pro			
210	215	220	
AAC TGG CAG CCC GTG CAG TGG CAT TCA AAA GTG CGG CAG AAG AGT GAG			720
Asn Trp Gln Pro Val Gln Trp His Ser Lys Val Arg Gln Lys Ser Glu			
225	230	235	240
GTG GAC ATT GTT GTT AGC GAA GAC TTG AAT GGA ACG GTG AAG TTT TCA			768
Val Asp Ile Val Val Ser Glu Asp Leu Asn Gly Thr Val Lys Phe Ser			
	245	250	255
AGC TCT TTA CCC TAC CCC AAT AAT CTT AAC AGT GTC CTG GCT GAG CGA			816
Ser Ser Leu Pro Tyr Pro Asn Asn Leu Asn Ser Val Leu Ala Glu Arg			
	260	265	270

CTG GAG AAG TGG CTG CAA CTG ATG CTG ATG TGG CAC CCC CGA CAG AGG	864
Leu Glu Lys Trp Leu Gln Leu Met Leu Met Trp His Pro Arg Gln Arg	
275 280 285	
GGC ACG GAT CCC ACG TAT GGG CCC AAT GGC TGC TTC AAG GCC CTG GAT	912
Gly Thr Asp Pro Thr Tyr Gly Pro Asn Gly Cys Phe Lys Ala Leu Asp	
290 295 300	
GAC ATC TTA AAC TTA AAG CTG GTT CAT ATC TTG AAC ATG GTC ACG GGC	960
Asp Ile Leu Asn Leu Lys Leu Val His Ile Leu Asn Met Val Thr Gly	
305 310 315 320	
ACC ATC CAC ACC TAC CCT GTG ACA GAG GAT GAG AGT CTG CAG AGC TTG	1008
Thr Ile His Thr Tyr Pro Val Thr Glu Asp Glu Ser Leu Gln Ser Leu	
325 330 335	
AAG GCC AGA ATC CAA CAG GAC ACG GGC ATC CCA GAG GAG GAC CAG GAG	1056
Lys Ala Arg Ile Gln Gln Asp Thr Gly Ile Pro Glu Glu Asp Gln Glu	
340 345 350	
CTG CTG CAG GAA GCG GGC CTG GCG TTG ATC CCC GAT AAG CCT GCC ACT	1104
Leu Leu Gln Glu Ala Gly Leu Ala Leu Ile Pro Asp Lys Pro Ala Thr	
355 360 365	
CAG TGT ATT TCA GAC GGC AAG TTA AAT GAG GGC CAC ACA TTG GAC ATG	1152
Gln Cys Ile Ser Asp Gly Lys Leu Asn Glu Gly His Thr Leu Asp Met	
370 375 380	
GAT CTT GTT TTT CTC TTT GAC AAC AGT AAA ATC ACC TAT GAG ACT CAG	1200
Asp Leu Val Phe Leu Phe Asp Asn Ser Lys Ile Thr Tyr Glu Thr Gln	
385 390 395 400	
ATC TCC CCA CGG CCC CAA CCT GAA AGT GTC AGC TGT ATC CTT CAA GAG	1248
Ile Ser Pro Arg Pro Gln Pro Glu Ser Val Ser Cys Ile Leu Gln Glu	
405 410 415	
CCC AAG AGG AAT CTC GCC TTC TTC CAG CTG AGG AAG GTG TGG GGC CAG	1296
Pro Lys Arg Asn Leu Ala Phe Phe Gln Leu Arg Lys Val Trp Gly Gln	
420 425 430	
GTC TGG CAC AGC ATC CAG ACC CTG AAG GAA GAT TGC AAC CGG CTG CAG	1344
Val Trp His Ser Ile Gln Thr Leu Lys Glu Asp Cys Asn Arg Leu Gln	
435 440 445	
CAG GGA CAG CGA GCC GCC ATG ATG AAT CTC CTC CGA AAC AAC AGC TGC	1392
Gln Gly Gln Arg Ala Ala Met Met Asn Leu Leu Arg Asn Asn Ser Cys	
450 455 460	
CTC TCC AAA ATG AAG AAT TCC ATG GCT TCC ATG TCT CAG CAG CTC AAG	1440
Leu Ser Lys Met Lys Asn Ser Met Ala Ser Met Ser Gln Gln Leu Lys	
465 470 475 480	
GCC AAG TTG GAT TTC TTC AAA ACC AGC ATC CAG ATT GAC CTG GAG AAG	1488
Ala Lys Leu Asp Phe Phe Lys Thr Ser Ile Gln Ile Asp Leu Glu Lys	

485	490	495	
TAC AGC GAG CAA ACC GAG TTT GGG ATC ACA TCA GAT AAA CTG CTG CTG			1536
Tyr Ser Glu Gln Thr Glu Phe Gly Ile Thr Ser Asp Lys Leu Leu Leu			
500	505	510	
GCC TGG AGG GAA ATG GAG CAG GCT GTG GAG CTC TGT GGG CGG GAG AAC			1584
Ala Trp Arg Glu Met Glu Gln Ala Val Glu Leu Cys Gly Arg Glu Asn			
515	520	525	
GAA GTG AAA CTC CTG GTA GAA CGG ATG ATG GCT CTG CAG ACC GAC ATT			1632
Glu Val Lys Leu Leu Val Glu Arg Met Met Ala Leu Gln Thr Asp Ile			
530	535	540	
GTG GAC TTA CAG AGG AGC CCC ATG GGC CGG AAG CAG GGG GGA ACG CTG			1680
Val Asp Leu Gln Arg Ser Pro Met Gly Arg Lys Gln Gly Gly Thr Leu			
545	550	555	560
GAC GAC CTA GAG GAG CAA GCA AGG GAG CTG TAC AGG AGA CTA AGG GAA			1728
Asp Asp Leu Glu Glu Gln Ala Arg Glu Leu Tyr Arg Arg Leu Arg Glu			
565	570	575	
AAA CCT CGA GAC CAG CGA ACT GAG GGT GAC AGT CAG GAA ATG GTA CGG			1776
Lys Pro Arg Asp Gln Arg Thr Glu Gly Asp Ser Gln Glu Met Val Arg			
580	585	590	
CTG CTG CTT CAG GCA ATT CAG AGC TTC GAG AAG AAA GTG CGA GTG ATC			1824
Leu Leu Leu Gln Ala Ile Gln Ser Phe Glu Lys Lys Val Arg Val Ile			
595	600	605	
TAT ACG CAG CTC AGT AAA ACT GTG GTT TGC AAG CAG AAG GCG CTG GAA			1872
Tyr Thr Gln Leu Ser Lys Thr Val Val Cys Lys Gln Lys Ala Leu Glu			
610	615	620	
CTG TTG CCC AAG GTG GAA GAG GTG GTG AGC TTA ATG AAT GAG GAT GAG			1920
Leu Leu Pro Lys Val Glu Glu Val Val Ser Leu Met Asn Glu Asp Glu			
625	630	635	640
AAG ACT GTT GTC CGG CTG CAG GAG AAG CGG CAG AAG GAG CTC TGG AAT			1968
Lys Thr Val Val Arg Leu Gln Glu Lys Arg Gln Lys Glu Leu Trp Asn			
645	650	655	
CTC CTG AAG ATT GCT TGT AGC AAG GTC CGT GGT CCT GTC AGT GGA AGC			2016
Leu Leu Lys Ile Ala Cys Ser Lys Val Arg Gly Pro Val Ser Gly Ser			
660	665	670	
CCG GAT AGC ATG AAT GCC TCT CGA CTT AGC CAG CCT GGG CAG CTG ATG			2064
Pro Asp Ser Met Asn Ala Ser Arg Leu Ser Gln Pro Gly Gln Leu Met			
675	680	685	
TCT CAG CCC TCC ACG GCC TCC AAC AGC TTA CCT GAG CCA GCC AAG AAG			2112
Ser Gln Pro Ser Thr Ala Ser Asn Ser Leu Pro Glu Pro Ala Lys Lys			
690	695	700	

AGT GAA GAA CTG GTG GCT GAA GCA CAT AAC CTC TGC ACC CTG CTA GAA Ser Glu Glu Leu Val Ala Glu Ala His Asn Leu Cys Thr Leu Leu Glu 705 710 715 720	2160
AAT GCC ATA CAG GAC ACT GTG AGG GAA CAA GAC CAG AGT TTC ACG GCC Asn Ala Ile Gln Asp Thr Val Arg Glu Gln Asp Gln Ser Phe Thr Ala 725 730 735	2208
CTA GAC TGG AGC TGG TTA CAG ACG GAA GAA GAA GAG CAC AGC TGC CTG Leu Asp Trp Ser Trp Leu Gln Thr Glu Glu Glu Glu His Ser Cys Leu 740 745 750	2256
GAG CAG GCC TCA TGG GTA CCG CGG GCC CGG GAT CCA CCG GTC GCC ACC Glu Gln Ala Ser Trp Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr 755 760 765	2304
ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG CCC ATC CTG Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu 770 775 780	2352
GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC GTG TCC GGC Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly 785 790 795 800	2400
GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG AAG TTC ATC Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile 805 810 815	2448
TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC GTG ACC ACC Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr 820 825 830	2496
CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC CAC ATG AAG Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys 835 840 845	2544
CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC GTC CAG GAG Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu 850 855 860	2592
CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC CGC GCC GAG Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu 865 870 875 880	2640
GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG CTG AAG GGC Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly 885 890 895	2688
ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG CTG GAG TAC Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr 900 905 910	2736
AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG CAG AAG AAC Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn	2784

915	920	925	
GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG GAC GGC AGC			2832
Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser			
930	935	940	
GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC GGC GAC GGC			2880
Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly			
945	950	955	960
CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG TCC GCC CTG			2928
Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu			
965	970	975	
AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG CTG GAG TTC			2976
Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe			
980	985	990	
GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG TAC AAG TAA			3024
Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys			
995	1000	1005	

## (2) INFORMATION FOR SEQ ID NO:153:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1007 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:153:

Met	Ser	Trp	Ser	Pro	Ser	Leu	Thr	Thr	Gln	Thr	Cys	Gly	Ala	Trp	Glu
1				5					10					15	
Met	Lys	Glu	Arg	Leu	Gly	Thr	Gly	Gly	Phe	Gly	Asn	Val	Ile	Arg	Trp
		20						25					30		
His	Asn	Gln	Glu	Thr	Gly	Glu	Gln	Ile	Ala	Ile	Lys	Gln	Cys	Arg	Gln
		35					40					45			
Glu	Leu	Ser	Pro	Arg	Asn	Arg	Glu	Arg	Trp	Cys	Leu	Glu	Ile	Gln	Ile
		50				55				60					
Met	Arg	Arg	Leu	Thr	His	Pro	Asn	Val	Val	Ala	Ala	Arg	Asp	Val	Pro
65					70					75				80	
Glu	Gly	Met	Gln	Asn	Leu	Ala	Pro	Asn	Asp	Leu	Pro	Leu	Leu	Ala	Met
			85					90					95		
Glu	Tyr	Cys	Gln	Gly	Gly	Asp	Leu	Arg	Lys	Tyr	Leu	Asn	Gln	Phe	Glu
			100				105					110			
Asn	Cys	Cys	Gly	Leu	Arg	Glu	Gly	Ala	Ile	Leu	Thr	Leu	Leu	Ser	Asp
		115				120						125			
Ile	Ala	Ser	Ala	Leu	Arg	Tyr	Leu	His	Glu	Asn	Arg	Ile	Ile	His	Arg
		130				135						140			



Asp	Leu	Lys	Pro	Glu	Asn	Ile	Val	Leu	Gln	Gln	Gly	Glu	Gln	Arg	Leu	145	150	155	160
Ile	His	Lys	Ile	Ile	Asp	Leu	Gly	Tyr	Ala	Lys	Glu	Leu	Asp	Gln	Gly	165	170	175	
Ser	Leu	Cys	Thr	Ser	Phe	Val	Gly	Thr	Leu	Gln	Tyr	Leu	Ala	Pro	Glu	180	185	190	
Leu	Leu	Glu	Gln	Gln	Lys	Tyr	Thr	Val	Thr	Val	Asp	Tyr	Trp	Ser	Phe	195	200	205	
Gly	Thr	Leu	Ala	Phe	Glu	Cys	Ile	Thr	Gly	Phe	Arg	Pro	Phe	Leu	Pro	210	215	220	
Asn	Trp	Gln	Pro	Val	Gln	Trp	His	Ser	Lys	Val	Arg	Gln	Lys	Ser	Glu	225	230	235	240
Val	Asp	Ile	Val	Val	Ser	Glu	Asp	Leu	Asn	Gly	Thr	Val	Lys	Phe	Ser	245	250	255	
Ser	Ser	Leu	Pro	Tyr	Pro	Asn	Asn	Leu	Asn	Ser	Val	Leu	Ala	Glu	Arg	260	265	270	
Leu	Glu	Lys	Trp	Leu	Gln	Leu	Met	Leu	Met	Trp	His	Pro	Arg	Gln	Arg	275	280	285	
Gly	Thr	Asp	Pro	Thr	Tyr	Gly	Pro	Asn	Gly	Cys	Phe	Lys	Ala	Leu	Asp	290	295	300	
Asp	Ile	Leu	Asn	Leu	Lys	Leu	Val	His	Ile	Leu	Asn	Met	Val	Thr	Gly	305	310	315	320
Thr	Ile	His	Thr	Tyr	Pro	Val	Thr	Glu	Asp	Glu	Ser	Leu	Gln	Ser	Leu	325	330	335	
Lys	Ala	Arg	Ile	Gln	Gln	Asp	Thr	Gly	Ile	Pro	Glu	Glu	Asp	Gln	Glu	340	345	350	
Leu	Leu	Gln	Glu	Ala	Gly	Leu	Ala	Leu	Ile	Pro	Asp	Lys	Pro	Ala	Thr	355	360	365	
Gln	Cys	Ile	Ser	Asp	Gly	Lys	Leu	Asn	Glu	Gly	His	Thr	Leu	Asp	Met	370	375	380	
Asp	Leu	Val	Phe	Leu	Phe	Asp	Asn	Ser	Lys	Ile	Thr	Tyr	Glu	Thr	Gln	385	390	395	400
Ile	Ser	Pro	Arg	Pro	Gln	Pro	Glu	Ser	Val	Ser	Cys	Ile	Leu	Gln	Glu	405	410	415	
Pro	Lys	Arg	Asn	Leu	Ala	Phe	Phe	Gln	Leu	Arg	Lys	Val	Trp	Gly	Gln	420	425	430	
Val	Trp	His	Ser	Ile	Gln	Thr	Leu	Lys	Glu	Asp	Cys	Asn	Arg	Leu	Gln	435	440	445	
Gln	Gly	Gln	Arg	Ala	Ala	Met	Met	Asn	Leu	Leu	Arg	Asn	Asn	Ser	Cys	450	455	460	
Leu	Ser	Lys	Met	Lys	Asn	Ser	Met	Ala	Ser	Met	Ser	Gln	Gln	Leu	Lys	465	470	475	480
Ala	Lys	Leu	Asp	Phe	Phe	Lys	Thr	Ser	Ile	Gln	Ile	Asp	Leu	Glu	Lys	485	490	495	
Tyr	Ser	Glu	Gln	Thr	Glu	Phe	Gly	Ile	Thr	Ser	Asp	Lys	Leu	Leu	Leu	500	505	510	
Ala	Trp	Arg	Glu	Met	Glu	Gln	Ala	Val	Glu	Leu	Cys	Gly	Arg	Glu	Asn	515	520	525	
Glu	Val	Lys	Leu	Leu	Val	Glu	Arg	Met	Met	Ala	Leu	Gln	Thr	Asp	Ile	530	535	540	
Val	Asp	Leu	Gln	Arg	Ser	Pro	Met	Gly	Arg	Lys	Gln	Gly	Gly	Thr	Leu	545	550	555	560
Asp	Asp	Leu	Glu	Glu	Gln	Ala	Arg	Glu	Leu	Tyr	Arg	Arg	Leu	Arg	Glu	565	570	575	

Lys Pro Arg Asp Gln Arg Thr Glu Gly Asp Ser Gln Glu Met Val Arg  
 580 585 590  
 Leu Leu Leu Gln Ala Ile Gln Ser Phe Glu Lys Lys Val Arg Val Ile  
 595 600 605  
 Tyr Thr Gln Leu Ser Lys Thr Val Val Cys Lys Gln Lys Ala Leu Glu  
 610 615 620  
 Leu Leu Pro Lys Val Glu Glu Val Val Ser Leu Met Asn Glu Asp Glu  
 625 630 635 640  
 Lys Thr Val Val Arg Leu Gln Glu Lys Arg Gln Lys Glu Leu Trp Asn  
 645 650 655  
 Leu Leu Lys Ile Ala Cys Ser Lys Val Arg Gly Pro Val Ser Gly Ser  
 660 665 670  
 Pro Asp Ser Met Asn Ala Ser Arg Leu Ser Gln Pro Gly Gln Leu Met  
 675 680 685  
 Ser Gln Pro Ser Thr Ala Ser Asn Ser Leu Pro Glu Pro Ala Lys Lys  
 690 695 700  
 Ser Glu Glu Leu Val Ala Glu Ala His Asn Leu Cys Thr Leu Leu Glu  
 705 710 715 720  
 Asn Ala Ile Gln Asp Thr Val Arg Glu Gln Asp Gln Ser Phe Thr Ala  
 725 730 735  
 Leu Asp Trp Ser Trp Leu Gln Thr Glu Glu Glu Glu His Ser Cys Leu  
 740 745 750  
 Glu Gln Ala Ser Trp Val Pro Arg Ala Arg Asp Pro Pro Val Ala Thr  
 755 760 765  
 Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val Pro Ile Leu  
 770 775 780  
 Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser Val Ser Gly  
 785 790 795 800  
 Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu Lys Phe Ile  
 805 810 815  
 Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu Val Thr Thr  
 820 825 830  
 Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp His Met Lys  
 835 840 845  
 Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr Val Gln Glu  
 850 855 860  
 Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr Arg Ala Glu  
 865 870 875 880  
 Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu Leu Lys Gly  
 885 890 895  
 Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys Leu Glu Tyr  
 900 905 910  
 Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys Gln Lys Asn  
 915 920 925  
 Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu Asp Gly Ser  
 930 935 940  
 Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile Gly Asp Gly  
 945 950 955 960  
 Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln Ser Ala Leu  
 965 970 975  
 Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu Leu Glu Phe  
 980 985 990  
 Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu Tyr Lys  
 995 1000 1005

## (2) INFORMATION FOR SEQ ID NO:154:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 2793 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: cDNA

## (ix) FEATURE:

- (A) NAME/KEY: Coding Sequence
- (B) LOCATION: 1...2790
- (D) OTHER INFORMATION:

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:154:

ATG ATG CAC GTG AAT AAT TTT CCC TTT AGA AGG CAT TCC TGG ATA TGT	48
Met Met His Val Asn Asn Phe Pro Phe Arg Arg His Ser Trp Ile Cys	
1 5 10 15	
TTT GAT GTG GAC AAT GGC ACA TCT GCG GGA CGG AGT CCC TTG GAT CCC	96
Phe Asp Val Asp Asn Gly Thr Ser Ala Gly Arg Ser Pro Leu Asp Pro	
20 25 30	
ATG ACC AGC CCA GGA TCC GGG CTA ATT CTC CAA GCA AAT TTT GTC CAC	144
Met Thr Ser Pro Gly Ser Gly Leu Ile Leu Gln Ala Asn Phe Val His	
35 40 45	
AGT CAA CGA CGG GAG TCC TTC CTG TAT CGA TCC GAC AGC GAT TAT GAC	192
Ser Gln Arg Arg Glu Ser Phe Leu Tyr Arg Ser Asp Ser Asp Tyr Asp	
50 55 60	
CTC TCT CCA AAG TCT ATG TCC CGG AAC TCC TCC ATT GCC AGT GAT ATA	240
Leu Ser Pro Lys Ser Met Ser Arg Asn Ser Ser Ile Ala Ser Asp Ile	
65 70 75 80	
CAC GGA GAT GAC TTG ATT GTG ACT CCA TTT GCT CAG GTC TTG GCC AGT	288
His Gly Asp Asp Leu Ile Val Thr Pro Phe Ala Gln Val Leu Ala Ser	
85 90 95	
CTG CGA ACT GTA CGA AAC AAC TTT GCT GCA TTA ACT AAT TTG CAA GAT	336
Leu Arg Thr Val Arg Asn Asn Phe Ala Ala Leu Thr Asn Leu Gln Asp	
100 105 110	
CGA GCA CCT AGC AAA AGA TCA CCC ATG TGC AAC CAA CCA TCC ATC AAC	384
Arg Ala Pro Ser Lys Arg Ser Pro Met Cys Asn Gln Pro Ser Ile Asn	
115 120 125	
AAA GCC ACC ATA ACA GAG GAG GCC TAC CAG AAA CTG GCC AGC GAG ACC	432
Lys Ala Thr Ile Thr Glu Glu Ala Tyr Gln Lys Leu Ala Ser Glu Thr	
130 135 140	

CTG GAG GAG CTG GAC TGG TGT CTG GAC CAG CTA GAG ACC CTA CAG ACC Leu Glu Glu Leu Asp Trp Cys Leu Asp Gln Leu Glu Thr Leu Gln Thr 145 150 155 160	480
AGG CAC TCC GTC AGT GAG ATG GCC TCC AAC AAG TTT AAA AGG ATG CTT Arg His Ser Val Ser Glu Met Ala Ser Asn Lys Phe Lys Arg Met Leu 165 170 175	528
AAT CGG GAG CTC ACC CAT CTC TCT GAA ATG AGT CGG TCT GGA AAT CAA Asn Arg Glu Leu Thr His Leu Ser Glu Met Ser Arg Ser Gly Asn Gln 180 185 190	576
GTG TCA GAG TTT ATA TCA AAC ACA TTC TTA GAT AAG CAA CAT GAA GTG Val Ser Glu Phe Ile Ser Asn Thr Phe Leu Asp Lys Gln His Glu Val 195 200 205	624
GAA ATT CCT TCT CCA ACT CAG AAG GAA AAG GAG AAA AAG AAA AGA CCA Glu Ile Pro Ser Pro Thr Gln Lys Glu Lys Glu Lys Lys Lys Arg Pro 210 215 220	672
ATG TCT CAG ATC AGT GGA GTC AAG AAA TTG ATG CAC AGC TCT AGT CTG Met Ser Gln Ile Ser Gly Val Lys Lys Leu Met His Ser Ser Ser Leu 225 230 235 240	720
ACT AAT TCA AGT ATC CCA AGG TTT GGA GTT AAA ACT GAA CAA GAA GAT Thr Asn Ser Ser Ile Pro Arg Phe Gly Val Lys Thr Glu Gln Glu Asp 245 250 255	768
GTC CTT GCC AAG GAA CTA GAA GAT GTG AAC AAA TGG GGT CTT CAT GTT Val Leu Ala Lys Glu Leu Glu Asp Val Asn Lys Trp Gly Leu His Val 260 265 270	816
TTC AGA ATA GCA GAG TTG TCT GGT AAC CGG CCC TTG ACT GTT ATC ATG Phe Arg Ile Ala Glu Leu Ser Gly Asn Arg Pro Leu Thr Val Ile Met 275 280 285	864
CAC ACC ATT TTT CAG GAA CGG GAT TTA TTA AAA ACA TTT AAA ATT CCA His Thr Ile Phe Gln Glu Arg Asp Leu Leu Lys Thr Phe Lys Ile Pro 290 295 300	912
GTA GAT ACT TTA ATT ACA TAT CTT ATG ACT CTC GAA GAC CAT TAC CAT Val Asp Thr Leu Ile Thr Tyr Leu Met Thr Leu Glu Asp His Tyr His 305 310 315 320	960
GCT GAT GTG GCC TAT CAC AAC AAT ATC CAT GCT GCA GAT GTT GTC CAG Ala Asp Val Ala Tyr His Asn Asn Ile His Ala Ala Asp Val Val Gln 325 330 335	1008
TCT ACT CAT GTG CTA TTA TCT ACA CCT GCT TTG GAG GCT GTG TTT ACA Ser Thr His Val Leu Leu Ser Thr Pro Ala Leu Glu Ala Val Phe Thr 340 345 350	1056
GAT TTG GAG ATT CTT GCA GCA ATT TTT GCC AGT GCA ATA CAT GAT GTA Asp Leu Glu Ile Leu Ala Ala Ile Phe Ala Ser Ala Ile His Asp Val	1104

355	360	365	
GAT CAT CCT GGT GTG TCC AAT CAA TTT CTG ATC AAT ACA AAC TCT GAA Asp His Pro Gly Val Ser Asn Gln Phe Leu Ile Asn Thr Asn Ser Glu 370 375 380			1152
CTT GCC TTG ATG TAC AAT GAT TCC TCA GTC TTA GAG AAC CAT CAT TTG Leu Ala Leu Met Tyr Asn Asp Ser Ser Val Leu Glu Asn His His Leu 385 390 395 400			1200
GCT GTG GGC TTT AAA TTG CTT CAG GAA GAA AAC TGT GAC ATT TTC CAG Ala Val Gly Phe Lys Leu Leu Gln Glu Glu Asn Cys Asp Ile Phe Gln 405 410 415			1248
AAT TTG ACC AAA AAA CAA AGA CAA TCT TTA AGG AAA ATG GTC ATT GAC Asn Leu Thr Lys Lys Gln Arg Gln Ser Leu Arg Lys Met Val Ile Asp 420 425 430			1296
ATC GTA CTT GCA ACA GAT ATG TCA AAA CAC ATG AAT CTA CTG GCT GAT Ile Val Leu Ala Thr Asp Met Ser Lys His Met Asn Leu Leu Ala Asp 435 440 445			1344
TTG AAG ACT ATG GTT GAA ACT AAG AAA GTG ACA AGC TCT GGA GTT CTT Leu Lys Thr Met Val Glu Thr Lys Lys Val Thr Ser Ser Gly Val Leu 450 455 460			1392
CTT CTT GAT AAT TAT TCC GAT AGG ATT CAG GTT CTT CAG AAT ATG GTG Leu Leu Asp Asn Tyr Ser Asp Arg Ile Gln Val Leu Gln Asn Met Val 465 470 475 480			1440
CAC TGT GCA GAT CTG AGC AAC CCA ACA AAG CCT CTC CAG CTG TAC CGC His Cys Ala Asp Leu Ser Asn Pro Thr Lys Pro Leu Gln Leu Tyr Arg 485 490 495			1488
CAG TGG ACG GAC CGG ATA ATG GAG GAG TTC TTC CGC CAA GGA GAC CGA Gln Trp Thr Asp Arg Ile Met Glu Glu Phe Phe Arg Gln Gly Asp Arg 500 505 510			1536
GAG AGG GAA CGT GGC ATG GAG ATA AGC CCC ATG TGT GAC AAG CAC AAT Glu Arg Glu Arg Gly Met Glu Ile Ser Pro Met Cys Asp Lys His Asn 515 520 525			1584
GCT TCC GTG GAA AAA TCA CAG GTG GGC TTC ATA GAC TAT ATT GTT CAT Ala Ser Val Glu Lys Ser Gln Val Gly Phe Ile Asp Tyr Ile Val His 530 535 540			1632
CCC CTC TGG GAG ACA TGG GCA GAC CTC GTC CAC CCT GAC GCC CAG GAT Pro Leu Trp Glu Thr Trp Ala Asp Leu Val His Pro Asp Ala Gln Asp 545 550 555 560			1680
ATT TTG GAC ACT TTG GAG GAC AAT CGT GAA TGG TAC CAG AGC ACA ATC Ile Leu Asp Thr Leu Glu Asp Asn Arg Glu Trp Tyr Gln Ser Thr Ile 565 570 575			1728

CCT CAG AGC CCC TCT CCT GCA CCT GAT GAC CCA GAG GAG GGC CGG CAG	1776
Pro Gln Ser Pro Ser Pro Ala Pro Asp Asp Pro Glu Glu Gly Arg Gln	
580 585 590	
GGT CAA ACT GAG AAA TTC CAG TTT GAA CTA ACT TTA GAG GAA GAT GGT	1824
Gly Gln Thr Glu Lys Phe Gln Phe Glu Leu Thr Leu Glu Glu Asp Gly	
595 600 605	
GAG TCA GAC ACG GAA AAG GAC AGT GGC AGT CAA GTG GAA GAA GAC ACT	1872
Glu Ser Asp Thr Glu Lys Asp Ser Gly Ser Gln Val Glu Glu Asp Thr	
610 615 620	
AGC TGC AGT GAC TCC AAG ACT CTT TGT ACT CAA GAC TCA GAG TCT ACT	1920
Ser Cys Ser Asp Ser Lys Thr Leu Cys Thr Gln Asp Ser Glu Ser Thr	
625 630 635 640	
GAA ATT CCC CTT GAT GAA CAG GTT GAA GAG GAG GCA GTA GGG GAA GAA	1968
Glu Ile Pro Leu Asp Glu Gln Val Glu Glu Glu Ala Val Gly Glu Glu	
645 650 655	
GAG GAA AGC CAG CCT GAA GCC TGT GTC ATA GAT GAT CGT TCT CCT GAC	2016
Glu Glu Ser Gln Pro Glu Ala Cys Val Ile Asp Asp Arg Ser Pro Asp	
660 665 670	
ACG ACG GGA ATT CTG CAG TCG ACG GTA CCG CGG GCC CGG GAT CCA CCG	2064
Thr Thr Gly Ile Leu Gln Ser Thr Val Pro Arg Ala Arg Asp Pro Pro	
675 680 685	
GTC GCC ACC ATG GTG AGC AAG GGC GAG GAG CTG TTC ACC GGG GTG GTG	2112
Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val	
690 695 700	
CCC ATC CTG GTC GAG CTG GAC GGC GAC GTA AAC GGC CAC AAG TTC AGC	2160
Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser	
705 710 715 720	
GTG TCC GGC GAG GGC GAG GGC GAT GCC ACC TAC GGC AAG CTG ACC CTG	2208
Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu	
725 730 735	
AAG TTC ATC TGC ACC ACC GGC AAG CTG CCC GTG CCC TGG CCC ACC CTC	2256
Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu	
740 745 750	
GTG ACC ACC CTG ACC TAC GGC GTG CAG TGC TTC AGC CGC TAC CCC GAC	2304
Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp	
755 760 765	
CAC ATG AAG CAG CAC GAC TTC TTC AAG TCC GCC ATG CCC GAA GGC TAC	2352
His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr	
770 775 780	
GTC CAG GAG CGC ACC ATC TTC TTC AAG GAC GAC GGC AAC TAC AAG ACC	2400
Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr	

785	790	795	800	
CGC GCC GAG GTG AAG TTC GAG GGC GAC ACC CTG GTG AAC CGC ATC GAG				2448
Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu				
	805	810	815	
CTG AAG GGC ATC GAC TTC AAG GAG GAC GGC AAC ATC CTG GGG CAC AAG				2496
Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys				
	820	825	830	
CTG GAG TAC AAC TAC AAC AGC CAC AAC GTC TAT ATC ATG GCC GAC AAG				2544
Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys				
	835	840	845	
CAG AAG AAC GGC ATC AAG GTG AAC TTC AAG ATC CGC CAC AAC ATC GAG				2592
Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu				
	850	855	860	
GAC GGC AGC GTG CAG CTC GCC GAC CAC TAC CAG CAG AAC ACC CCC ATC				2640
Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile				
	865	870	875	880
GGC GAC GGC CCC GTG CTG CTG CCC GAC AAC CAC TAC CTG AGC ACC CAG				2688
Gly Asp Gly Pro Val Leu Leu Pro Asp Asn His Tyr Leu Ser Thr Gln				
	885	890	895	
TCC GCC CTG AGC AAA GAC CCC AAC GAG AAG CGC GAT CAC ATG GTC CTG				2736
Ser Ala Leu Ser Lys Asp Pro Asn Glu Lys Arg Asp His Met Val Leu				
	900	905	910	
CTG GAG TTC GTG ACC GCC GCC GGG ATC ACT CTC GGC ATG GAC GAG CTG				2784
Leu Glu Phe Val Thr Ala Ala Gly Ile Thr Leu Gly Met Asp Glu Leu				
	915	920	925	
TAC AAG TAA				2793
Tyr Lys				
930				

## (2) INFORMATION FOR SEQ ID NO:155:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 930 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (v) FRAGMENT TYPE: internal

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:155:

Met	Met	His	Val	Asn	Asn	Phe	Pro	Phe	Arg	Arg	His	Ser	Trp	Ile	Cys
1				5				10					15		

Phe Asp Val Asp Asn Gly Thr Ser Ala Gly Arg Ser Pro Leu Asp Pro  
 20 25 30  
 Met Thr Ser Pro Gly Ser Gly Leu Ile Leu Gln Ala Asn Phe Val His  
 35 40 45  
 Ser Gln Arg Arg Glu Ser Phe Leu Tyr Arg Ser Asp Ser Asp Tyr Asp  
 50 55 60  
 Leu Ser Pro Lys Ser Met Ser Arg Asn Ser Ser Ile Ala Ser Asp Ile  
 65 70 75 80  
 His Gly Asp Asp Leu Ile Val Thr Pro Phe Ala Gln Val Leu Ala Ser  
 85 90 95  
 Leu Arg Thr Val Arg Asn Asn Phe Ala Ala Leu Thr Asn Leu Gln Asp  
 100 105 110  
 Arg Ala Pro Ser Lys Arg Ser Pro Met Cys Asn Gln Pro Ser Ile Asn  
 115 120 125  
 Lys Ala Thr Ile Thr Glu Glu Ala Tyr Gln Lys Leu Ala Ser Glu Thr  
 130 135 140  
 Leu Glu Glu Leu Asp Trp Cys Leu Asp Gln Leu Glu Thr Leu Gln Thr  
 145 150 155 160  
 Arg His Ser Val Ser Glu Met Ala Ser Asn Lys Phe Lys Arg Met Leu  
 165 170 175  
 Asn Arg Glu Leu Thr His Leu Ser Glu Met Ser Arg Ser Gly Asn Gln  
 180 185 190  
 Val Ser Glu Phe Ile Ser Asn Thr Phe Leu Asp Lys Gln His Glu Val  
 195 200 205  
 Glu Ile Pro Ser Pro Thr Gln Lys Glu Lys Glu Lys Lys Lys Arg Pro  
 210 215 220  
 Met Ser Gln Ile Ser Gly Val Lys Lys Leu Met His Ser Ser Ser Leu  
 225 230 235 240  
 Thr Asn Ser Ser Ile Pro Arg Phe Gly Val Lys Thr Glu Gln Glu Asp  
 245 250 255  
 Val Leu Ala Lys Glu Leu Glu Asp Val Asn Lys Trp Gly Leu His Val  
 260 265 270  
 Phe Arg Ile Ala Glu Leu Ser Gly Asn Arg Pro Leu Thr Val Ile Met  
 275 280 285  
 His Thr Ile Phe Gln Glu Arg Asp Leu Leu Lys Thr Phe Lys Ile Pro  
 290 295 300  
 Val Asp Thr Leu Ile Thr Tyr Leu Met Thr Leu Glu Asp His Tyr His  
 305 310 315 320  
 Ala Asp Val Ala Tyr His Asn Asn Ile His Ala Ala Asp Val Val Gln  
 325 330 335  
 Ser Thr His Val Leu Leu Ser Thr Pro Ala Leu Glu Ala Val Phe Thr  
 340 345 350  
 Asp Leu Glu Ile Leu Ala Ala Ile Phe Ala Ser Ala Ile His Asp Val  
 355 360 365  
 Asp His Pro Gly Val Ser Asn Gln Phe Leu Ile Asn Thr Asn Ser Glu  
 370 375 380  
 Leu Ala Leu Met Tyr Asn Asp Ser Ser Val Leu Glu Asn His His Leu  
 385 390 395 400  
 Ala Val Gly Phe Lys Leu Leu Gln Glu Glu Asn Cys Asp Ile Phe Gln  
 405 410 415  
 Asn Leu Thr Lys Lys Gln Arg Gln Ser Leu Arg Lys Met Val Ile Asp  
 420 425 430  
 Ile Val Leu Ala Thr Asp Met Ser Lys His Met Asn Leu Leu Ala Asp  
 435 440 445



Leu Lys Thr Met Val Glu Thr Lys Lys Val Thr Ser Ser Gly Val Leu  
 450 455 460  
 Leu Leu Asp Asn Tyr Ser Asp Arg Ile Gln Val Leu Gln Asn Met Val  
 465 470 475 480  
 His Cys Ala Asp Leu Ser Asn Pro Thr Lys Pro Leu Gln Leu Tyr Arg  
 485 490 495  
 Gln Trp Thr Asp Arg Ile Met Glu Glu Phe Phe Arg Gln Gly Asp Arg  
 500 505 510  
 Glu Arg Glu Arg Gly Met Glu Ile Ser Pro Met Cys Asp Lys His Asn  
 515 520 525  
 Ala Ser Val Glu Lys Ser Gln Val Gly Phe Ile Asp Tyr Ile Val His  
 530 535 540  
 Pro Leu Trp Glu Thr Trp Ala Asp Leu Val His Pro Asp Ala Gln Asp  
 545 550 555 560  
 Ile Leu Asp Thr Leu Glu Asp Asn Arg Glu Trp Tyr Gln Ser Thr Ile  
 565 570 575  
 Pro Gln Ser Pro Ser Pro Ala Pro Asp Asp Pro Glu Glu Gly Arg Gln  
 580 585 590  
 Gly Gln Thr Glu Lys Phe Gln Phe Glu Leu Thr Leu Glu Glu Asp Gly  
 595 600 605  
 Glu Ser Asp Thr Glu Lys Asp Ser Gly Ser Gln Val Glu Glu Asp Thr  
 610 615 620  
 Ser Cys Ser Asp Ser Lys Thr Leu Cys Thr Gln Asp Ser Glu Ser Thr  
 625 630 635 640  
 Glu Ile Pro Leu Asp Glu Gln Val Glu Glu Ala Val Gly Glu Glu  
 645 650 655  
 Glu Glu Ser Gln Pro Glu Ala Cys Val Ile Asp Asp Arg Ser Pro Asp  
 660 665 670  
 Thr Thr Gly Ile Leu Gln Ser Thr Val Pro Arg Ala Arg Asp Pro Pro  
 675 680 685  
 Val Ala Thr Met Val Ser Lys Gly Glu Glu Leu Phe Thr Gly Val Val  
 690 695 700  
 Pro Ile Leu Val Glu Leu Asp Gly Asp Val Asn Gly His Lys Phe Ser  
 705 710 715 720  
 Val Ser Gly Glu Gly Glu Gly Asp Ala Thr Tyr Gly Lys Leu Thr Leu  
 725 730 735  
 Lys Phe Ile Cys Thr Thr Gly Lys Leu Pro Val Pro Trp Pro Thr Leu  
 740 745 750  
 Val Thr Thr Leu Thr Tyr Gly Val Gln Cys Phe Ser Arg Tyr Pro Asp  
 755 760 765  
 His Met Lys Gln His Asp Phe Phe Lys Ser Ala Met Pro Glu Gly Tyr  
 770 775 780  
 Val Gln Glu Arg Thr Ile Phe Phe Lys Asp Asp Gly Asn Tyr Lys Thr  
 785 790 795 800  
 Arg Ala Glu Val Lys Phe Glu Gly Asp Thr Leu Val Asn Arg Ile Glu  
 805 810 815  
 Leu Lys Gly Ile Asp Phe Lys Glu Asp Gly Asn Ile Leu Gly His Lys  
 820 825 830  
 Leu Glu Tyr Asn Tyr Asn Ser His Asn Val Tyr Ile Met Ala Asp Lys  
 835 840 845  
 Gln Lys Asn Gly Ile Lys Val Asn Phe Lys Ile Arg His Asn Ile Glu  
 850 855 860  
 Asp Gly Ser Val Gln Leu Ala Asp His Tyr Gln Gln Asn Thr Pro Ile  
 865 870 875 880

(2) INFORMATION FOR SEQ ID NO:156:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 37 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:156:

GTAAGCTTCG AACATGATGC ACGTGAATAA TTTTCCC

37

(2) INFORMATION FOR SEQ ID NO:157:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 34 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:157:

GTAAGCTTCG AACATGGAGG CAGAGGGCAG CAGC

34

(2) INFORMATION FOR SEQ ID NO:158:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 34 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:158:

GTAAGCTTCG AACATGGCTC AGCAGACAAG CCG

34

(2) INFORMATION FOR SEQ ID NO:159:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 37 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single

(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:159:

GTGAATTCCC GTCGTGTCAG GAGAAGCATC ATCTATG

37

(2) INFORMATION FOR SEQ ID NO:160:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 24 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:160:

GTGAATTCAA CCATGGAGCG GGCC

24

(2) INFORMATION FOR SEQ ID NO:161:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 23 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:161:

GTGGTACCCA GTTCCGCTTG GCC

23

(2) INFORMATION FOR SEQ ID NO:162:

(i) SEQUENCE CHARACTERISTICS:

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- (B) TYPE: nucleic acid
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- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:162:

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24

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(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 25 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:163:

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25

(2) INFORMATION FOR SEQ ID NO:164:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 31 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:164:

GTAAGCTTAC ATGAGCTGGT CACCTTCCCT G

31

(2) INFORMATION FOR SEQ ID NO:165:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 25 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

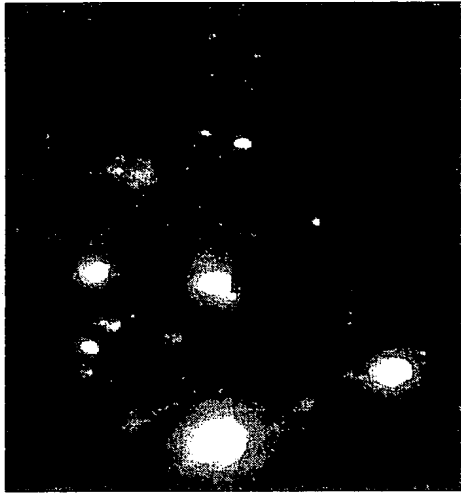
(ii) MOLECULE TYPE: cDNA

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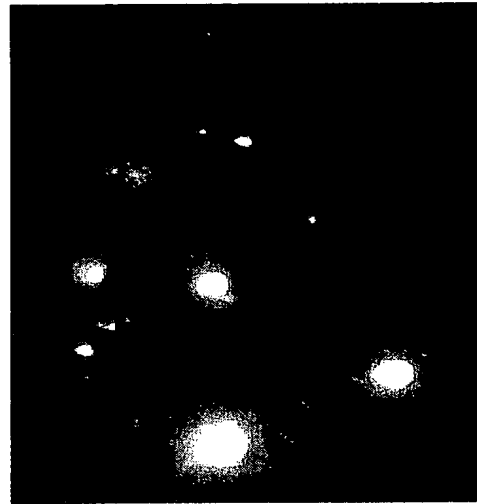
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25

Figure 1



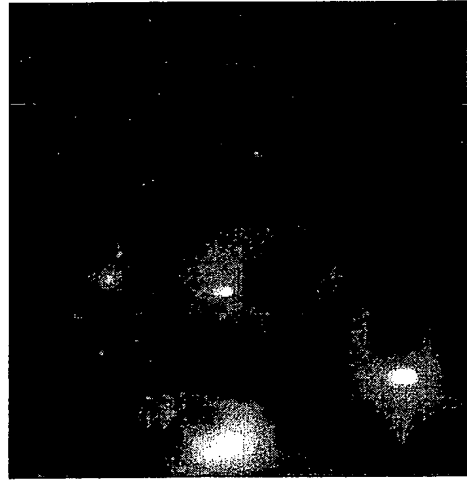
a)



b)



c)



d)

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Figure 2

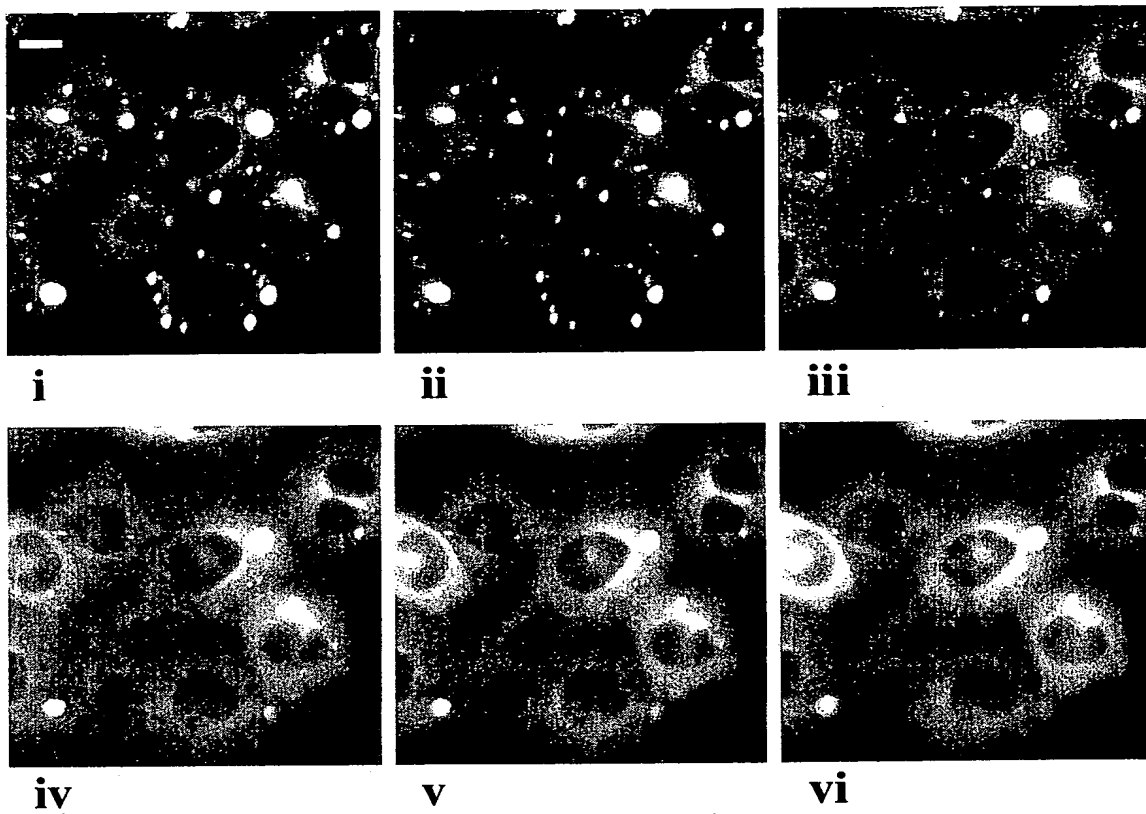
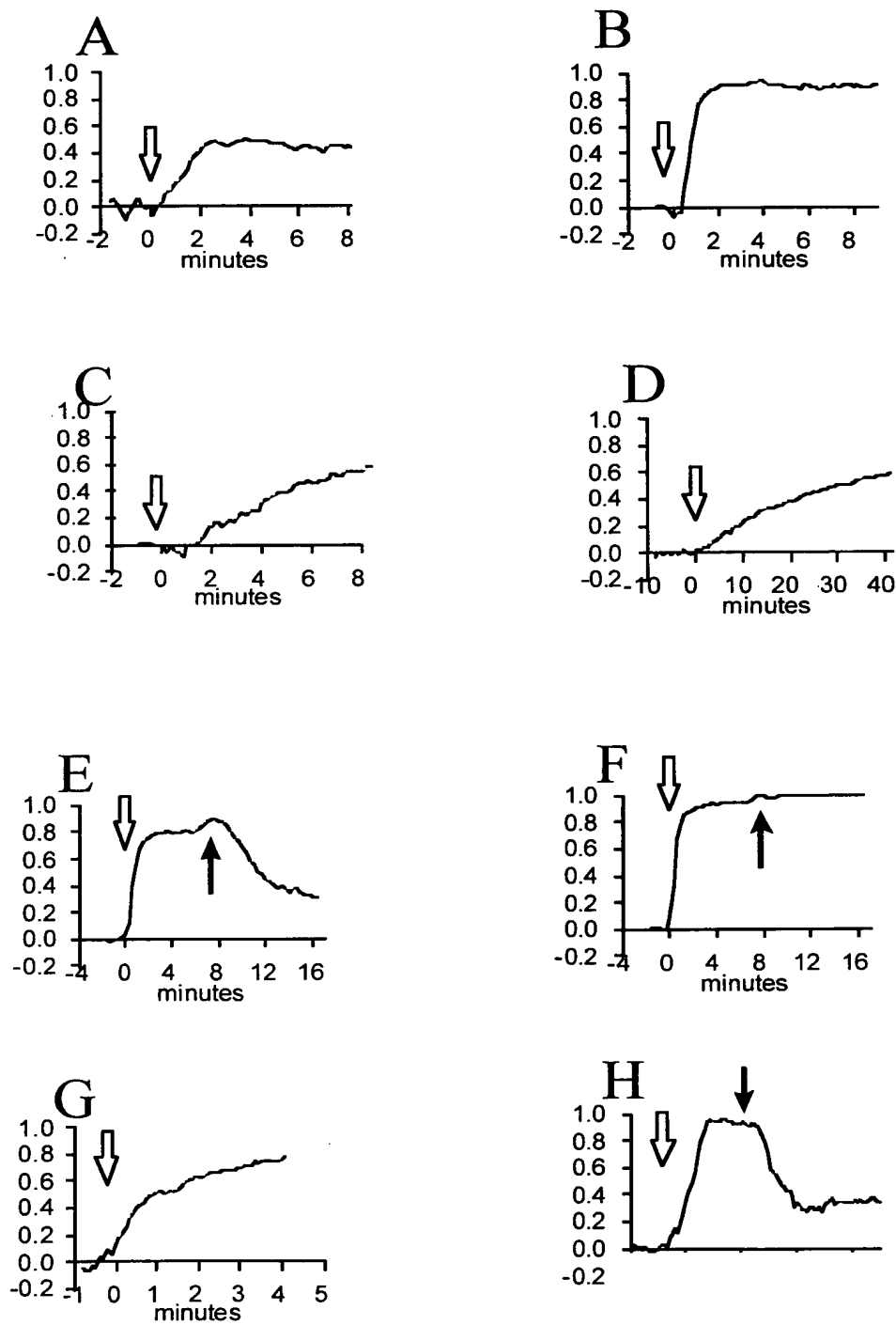


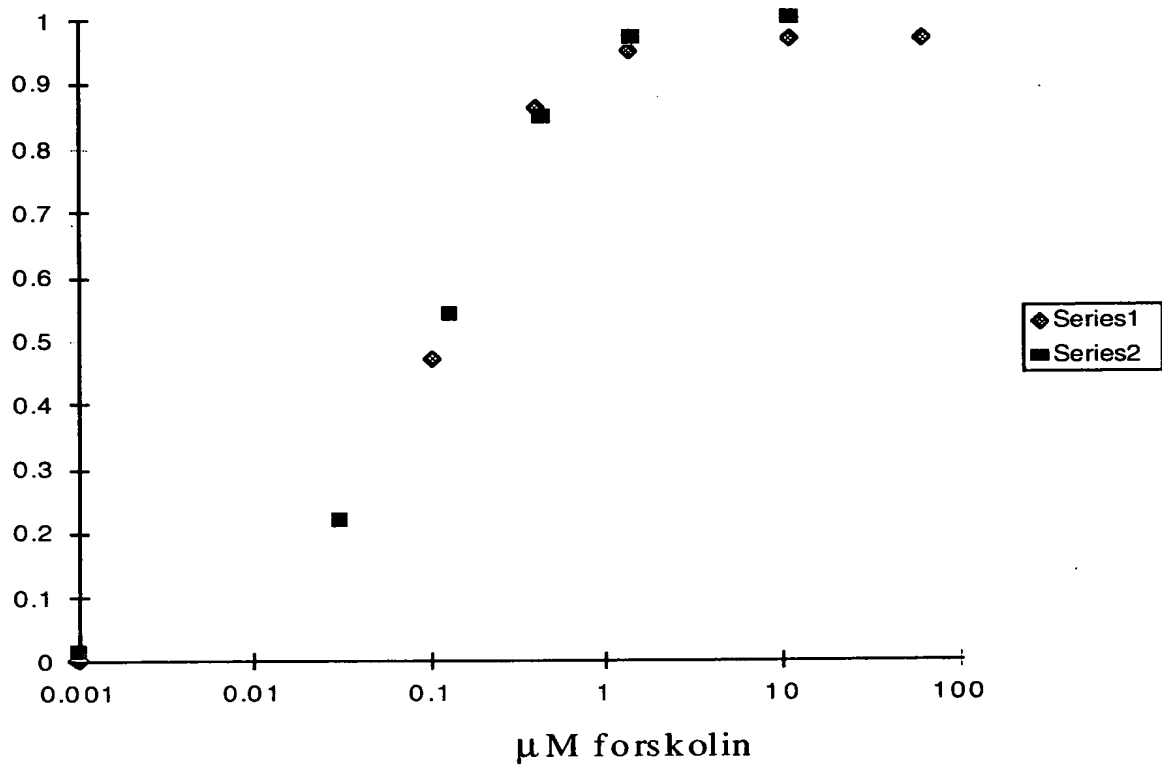
Figure 3



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Figure 4





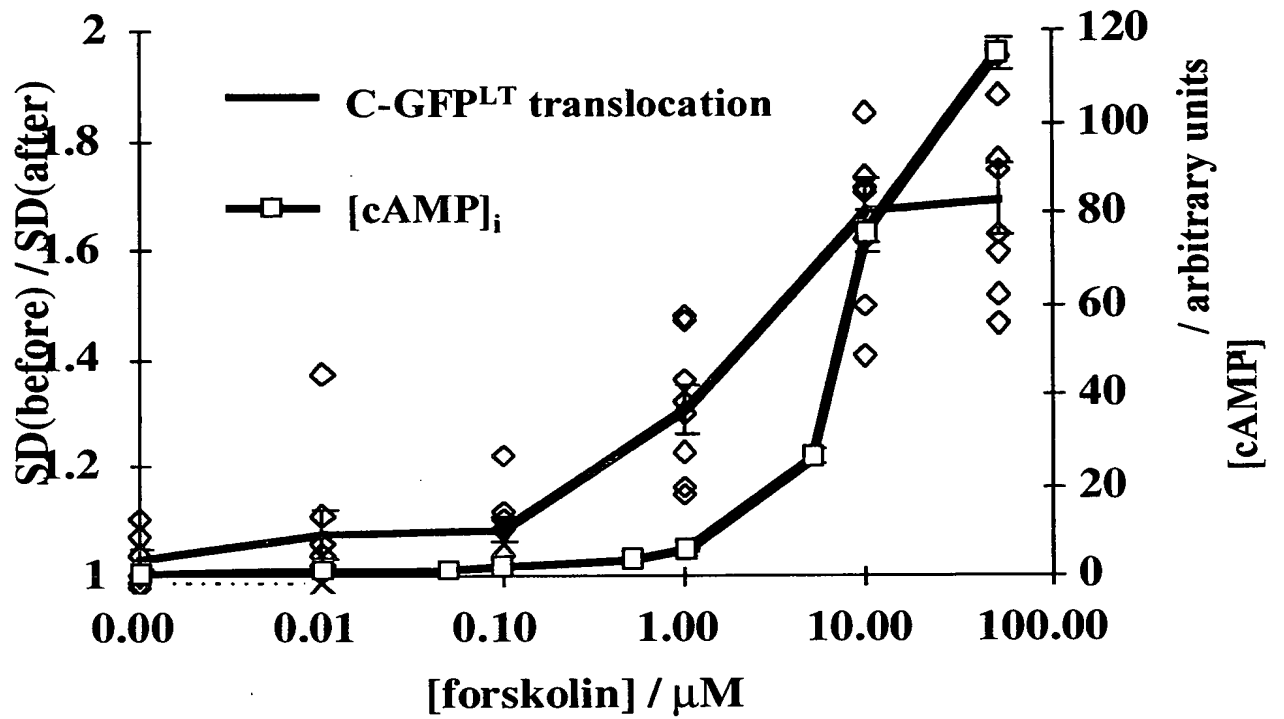
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Figure 5

[forskolin] $\mu$ M	$t_{1/2\max}$ / s	$t_{\max}$ / s
1	$115\pm 21$	$310\pm 31$
10	$69\pm 14$	$224\pm 47$
50	$47\pm 10$	$125\pm 28$

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Figure 6



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Figure 7



a)

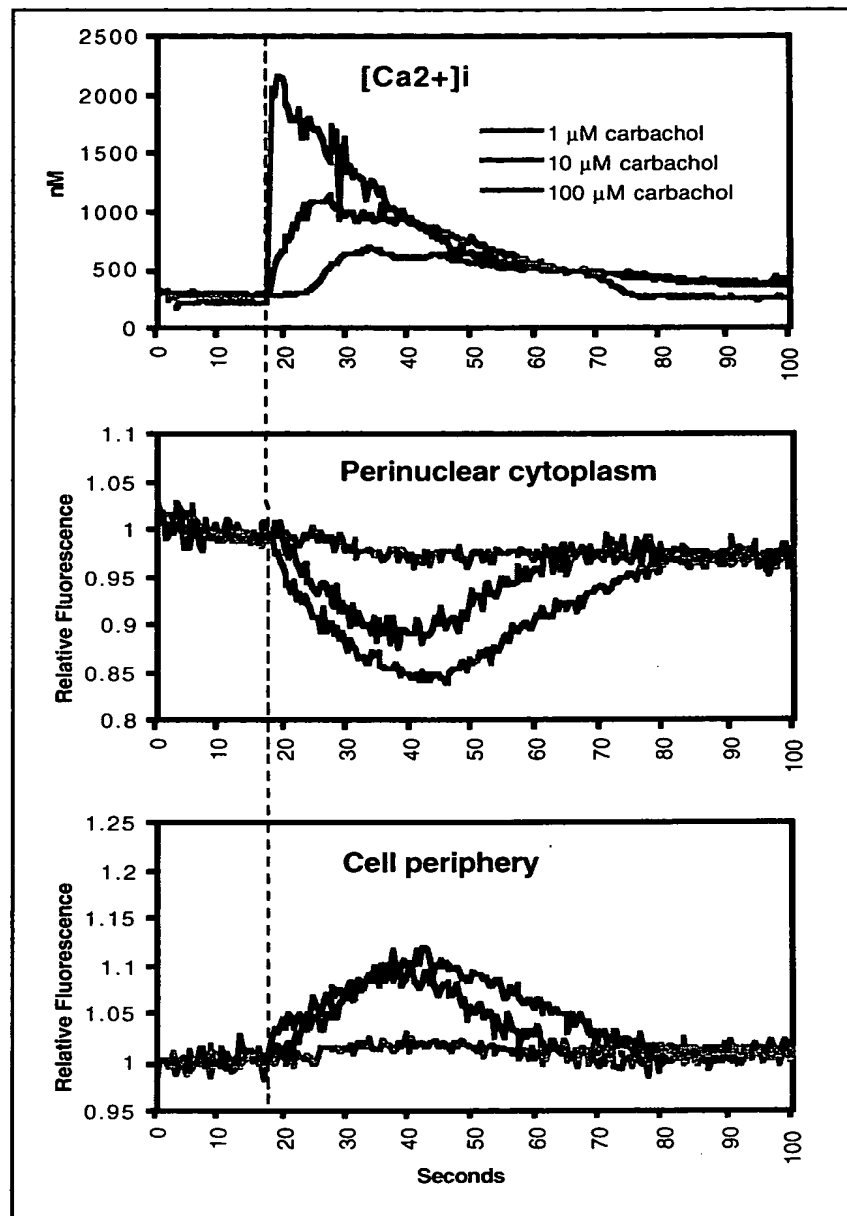


b)

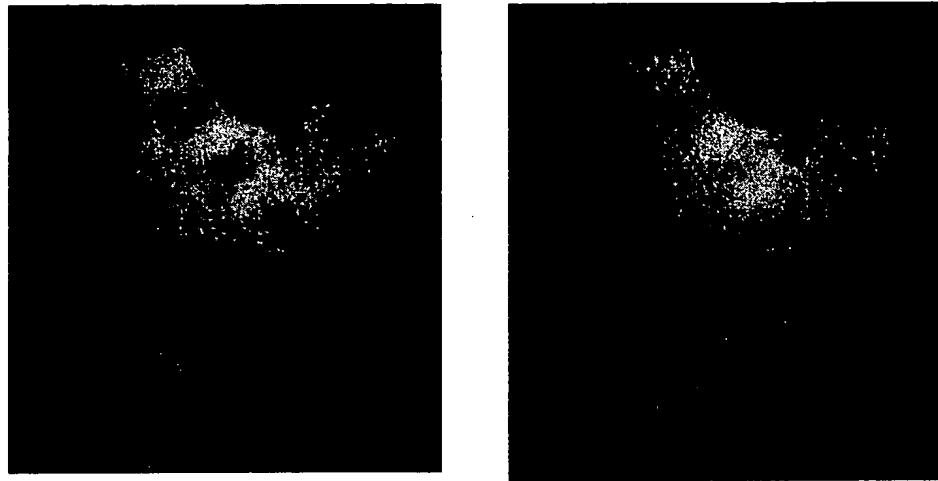


c)

Figure 8

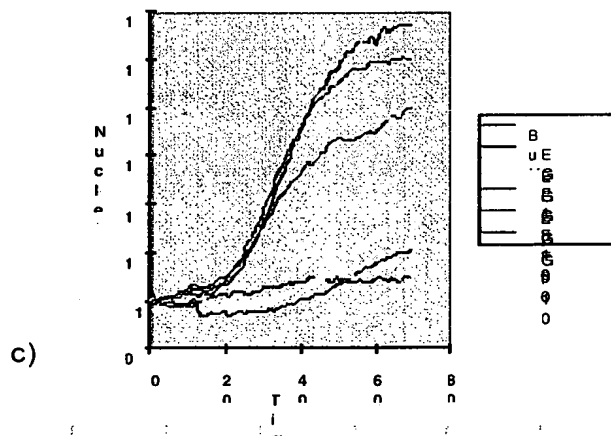


### Figure 9

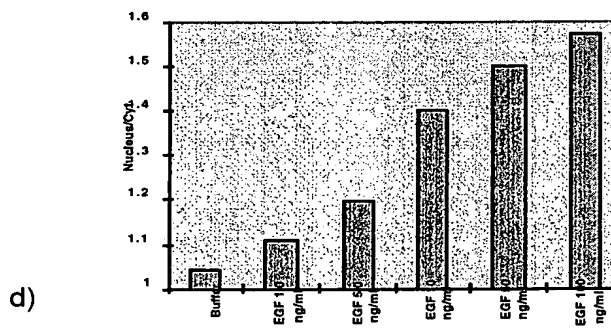


a)

**b)**



c)



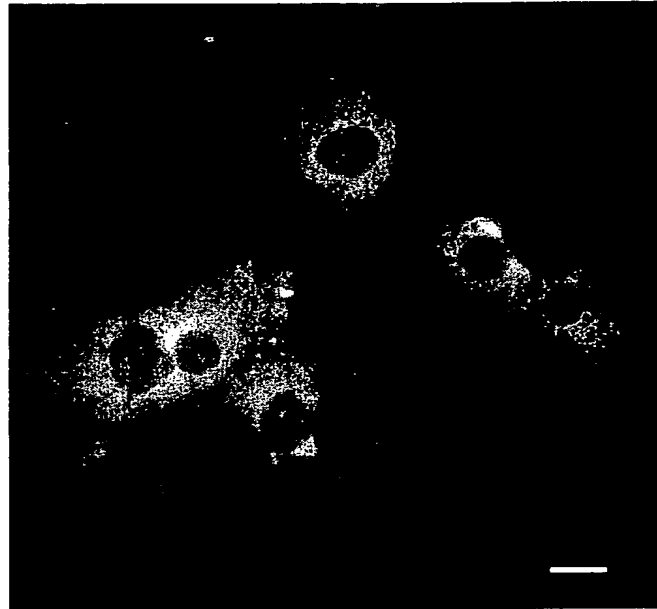
d)

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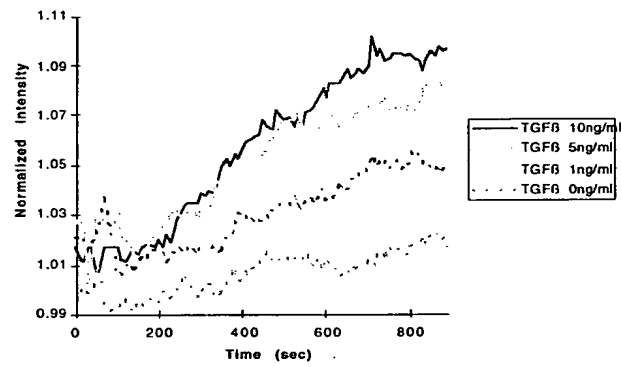
10

Figure 10

a)



b)



c)

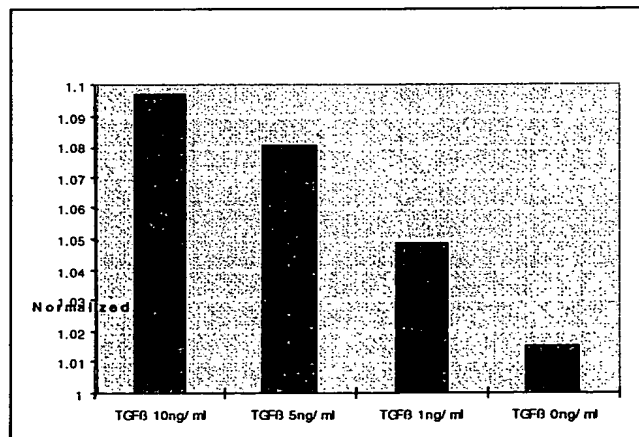
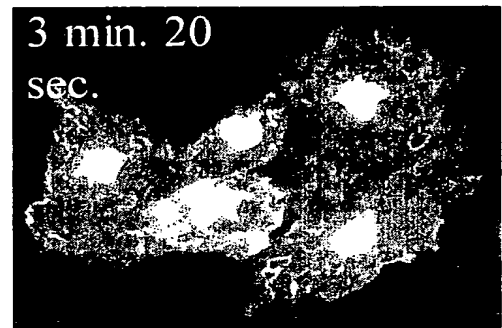
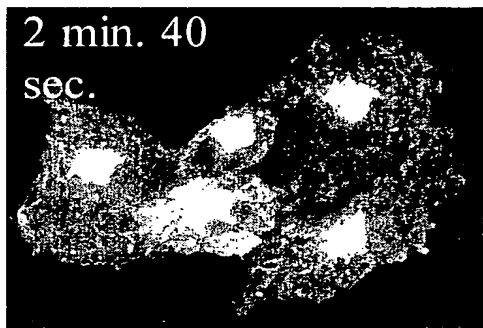
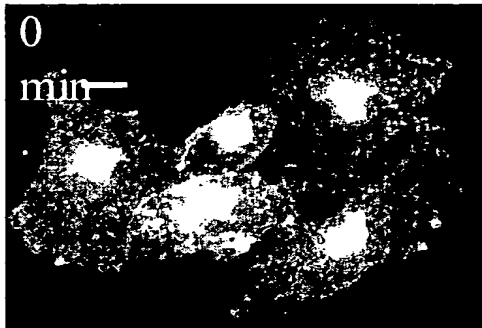


Figure 11



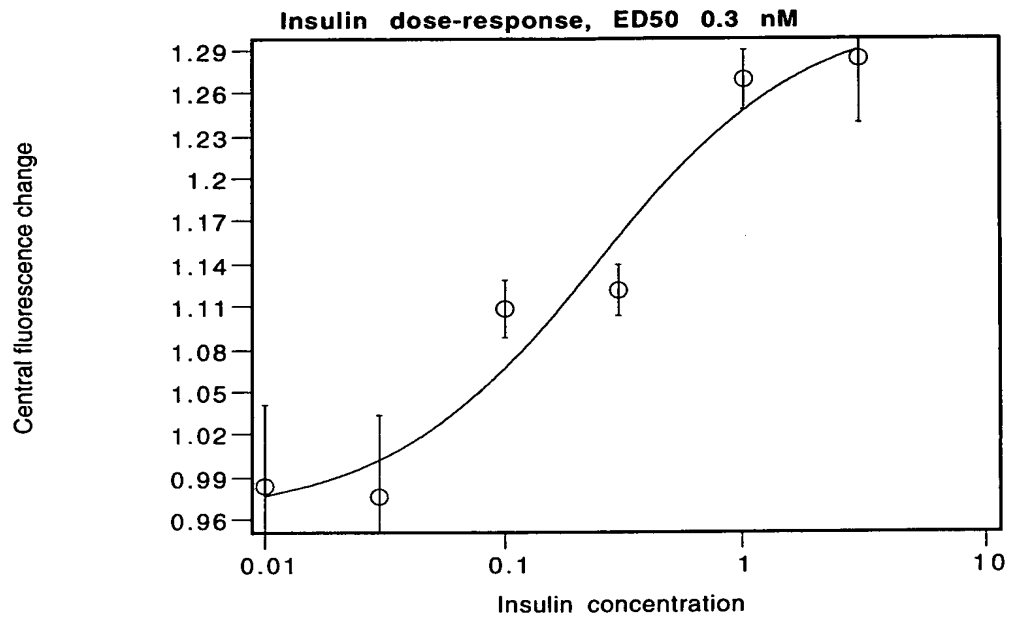
Fig. 12





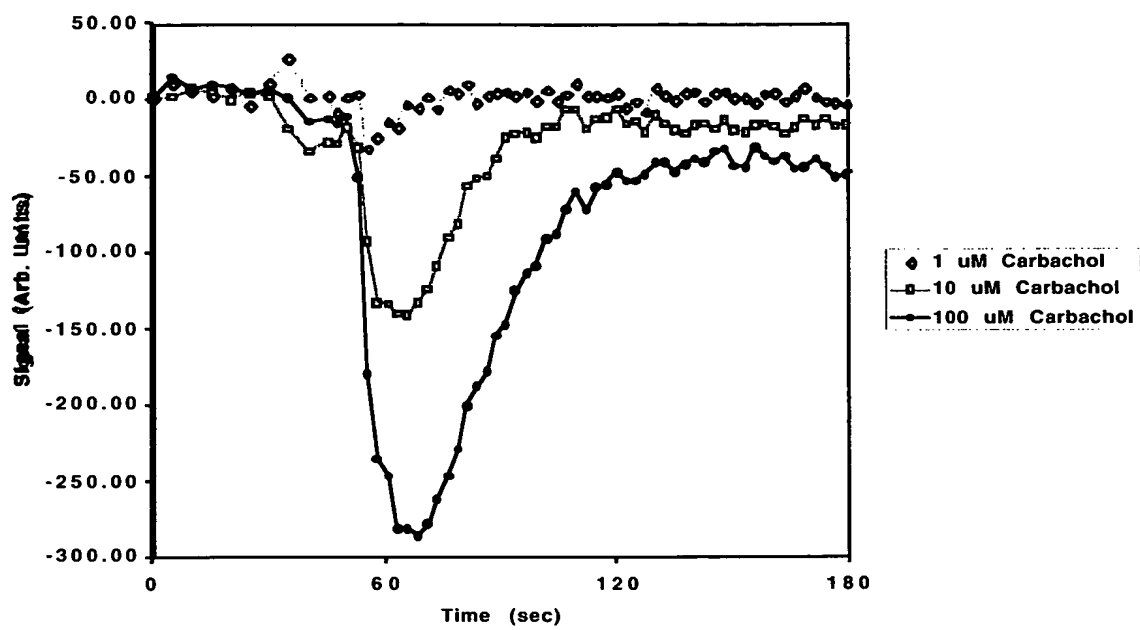
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Figure 13



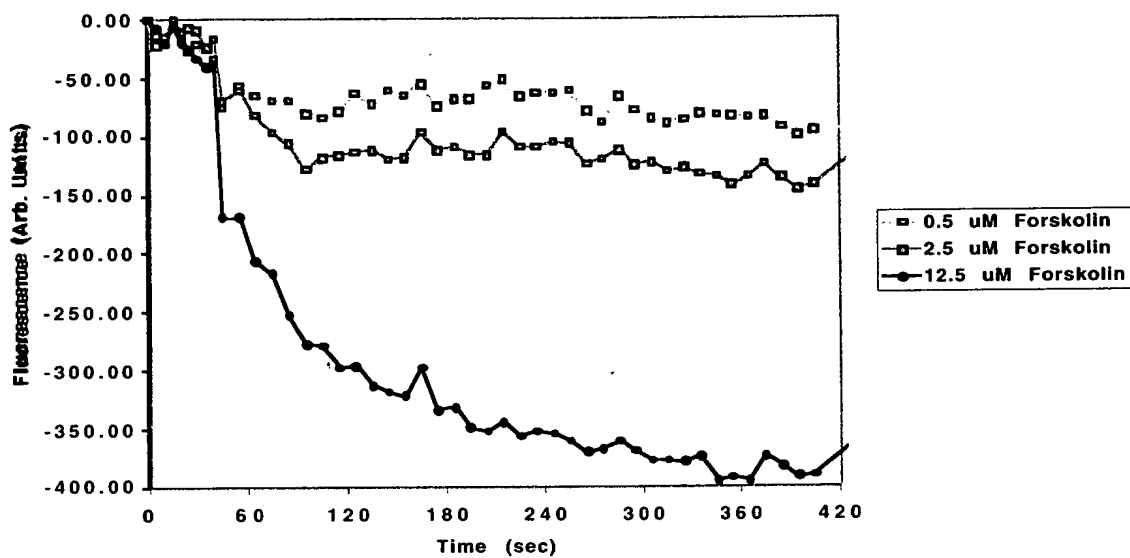
Modtaget PD  
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Figure 14



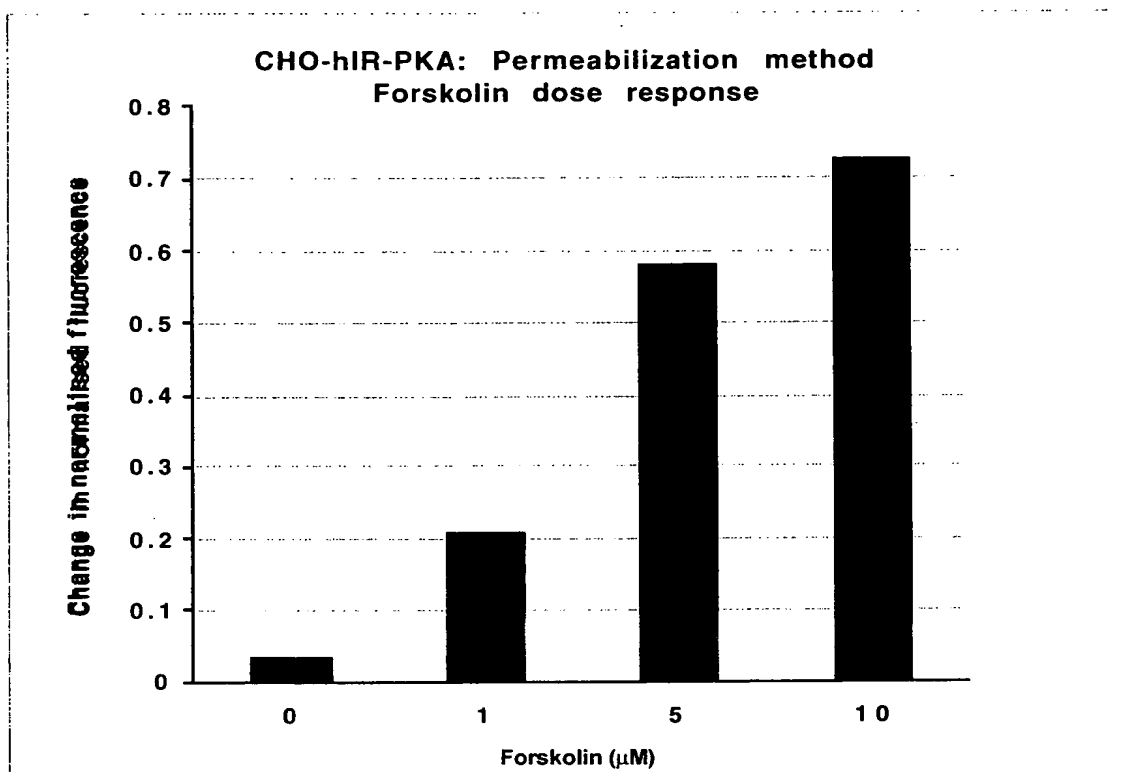
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Figure 15



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Figure 16



## **Changes in intracellular cAMP visualised using a cAMP-dependent protein kinase-green fluorescent protein hybrid.**

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Keywords: PKA, cAK, C-subunit, cAMP, measurement, live-cell, GFP, redistribution

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## ABSTRACT

A novel method to monitor changes in intracellular cAMP concentration ( $[cAMP]_i$ ) within intact living cells has been developed based on a fusion of the catalytic subunit of cAMP-dependent protein kinase to green fluorescent protein (GFP). In stably transfected unstimulated fibroblasts, fusion protein fluorescence was highly concentrated in aggregates throughout the cytoplasm and absent in the nucleus. Stimulation with the adenylate cyclase activator forskolin caused the release of tagged catalytic subunits from the cytoplasmic aggregates within minutes, resulting in an increasingly homogeneous distribution of GFP fluorescence throughout the cytoplasm. The observed redistribution was completely reversible: removal of forskolin led to the return of fluorescence to the cytoplasmic aggregates. Spot-photobleach measurements showed that the rate of exchange of GFP-labelled catalytic subunits at these aggregates increased in proportion to  $[cAMP]_i$ . The localisation of the fusion protein was also sensitive to receptor stimulation. In fibroblasts stably expressing the  $G_i$ -protein coupled glucagon receptor, generation of an increased  $[cAMP]_i$  through glucagon stimulation resulted in a redistribution of tagged catalytic subunit similar to that observed after forskolin addition. Conversely, in fibroblasts overexpressing the  $G_i$ -protein coupled  $\alpha_2a$  adrenoreceptor, addition of norepinephrine after forskolin stimulation led to a reversal of the fusion protein redistribution.

## INTRODUCTION

The cAMP-dependent protein kinase (cAK)<sup>1</sup> is a ubiquitous serine/threonine protein kinase. cAK is recognised as the only mediator of intracellular cAMP signals in eukaryotes<sup>2</sup>, with the exception of certain ion channels<sup>3</sup>. The cAK holoenzyme is an  $R_2C_2$  tetramer consisting of a regulatory (R) dimer and two catalytic (C) subunits<sup>2</sup>. Presently, four isoforms of the regulatory subunit ( $RI\alpha$ ,  $RI\beta$ ,  $RII\alpha$  and  $RII\beta$ ) and three isoforms of the catalytic subunit ( $C\alpha$ ,  $C\beta$  and  $C\gamma$ ) have been described<sup>2</sup>. Splice variants of  $C\alpha$  and  $C\beta$ <sup>4</sup> and possible R heterodimers, as reported for  $RI\alpha$  and  $RI\beta$ <sup>5</sup>, add to the complexity of the cAK holoenzyme. Although the  $C\gamma$  isoform is unique with respect to substrate specificity, inhibition and tissue distribution<sup>6</sup>, few reports suggest different roles for  $C\alpha$  and  $C\beta$  isoforms of the catalytic subunit<sup>7</sup>. In contrast, the RI and RII subunits are reported to be distinct. The cAKI ( $RI_2C_2$ ) holoenzyme is thought to be mainly soluble and cytoplasmic<sup>2</sup> although RI is reported to be associated with

sarcoplasmic membranes<sup>8</sup> and also with a detergent-resistant structure in mammalian sperm<sup>9</sup>. cAKII (RII<sub>2</sub>C<sub>2</sub>) on the other hand is thought to be particulate and RII has been reported to bind to a number of intracellular components, most notably Golgi membranes<sup>10,11</sup> and centrosomes<sup>10,11</sup> but also mitochondria<sup>12</sup>, nuclei<sup>13,14</sup> and cytoskeletal components<sup>11,12</sup>. RII subunits interact with a family of proteins called A-kinase anchoring proteins (AKAP)<sup>15</sup> and this may also be true of RI subunits<sup>16</sup>. The AKAP-RII subunit interaction is presumed to be responsible for localising the cAKII tetramer at these intracellular sites. The NH<sub>2</sub>-terminus of the C subunit is myristoylated<sup>17</sup>, a post-translational modification usually associated with membrane insertion. However, the C subunit does not appear to be membrane attached and while myristoylation may increase the thermostability of the protein, the possible role of myristoylation in its targeting or substrate specificity is still not clear<sup>18</sup>.

The C subunit in the assembled tetramer is believed, although not unanimously<sup>19</sup>, to be catalytically inactive. Activation of cAK is physiologically mediated through G<sub>i</sub>-protein coupled plasma membrane receptors. G<sub>i</sub>-protein activation leads to activation of adenylate cyclases, which generate cAMP. Binding of two molecules of cAMP to each R subunit causes the release and activation of the C subunits. Dissociated C subunits phosphorylate cytoplasmic substrates<sup>20,21</sup> and have been shown to relocate to the nucleus<sup>22</sup>. The nuclear redistribution mechanism of C subunits may be by simple diffusion through nuclear pores<sup>21</sup>. To date a large number of cytoplasmic and a few nuclear cAK substrates have been reported. An incomplete list of 25 *in vitro* substrates<sup>23</sup> includes several enzymes involved in basic metabolism such as phosphorylase kinase, glycogen synthase and fructose biphosphatase. Nuclear C subunit regulates transcription of genes under control of the cAMP response element (CRE) by phosphorylating the continuously bound CRE binding protein, (CREB)<sup>24,25</sup>.

Several factors decrease the level of cAK activity. Stimulation of plasma membrane bound G<sub>i</sub>-protein coupled receptors inhibits adenylate cyclases and cAMP is continuously being broken down by a variety of phosphodiesterases. Despite the importance of the cAMP/cAK signalling pathway, there is no easy method to monitor intracellular cAMP concentrations ([cAMP]<sub>i</sub>) in intact living cells. The current method of choice involves fluorescence resonance energy transfer (FRET) between microinjected fluorescently labelled R and C subunits<sup>26</sup>. In the work described herein, the C $\alpha$  subunit was tagged with a highly fluorescent variant of green fluorescent protein (GFP) containing F64L and S65T amino acid substitutions (GFP<sup>LT</sup>) (International

Publication No. WO97/11094). This approach provides a transfectable probe for monitoring the intracellular trafficking of C subunits in response to changes in  $[cAMP]_i$  and represents the first easy method to evaluate changes in  $[cAMP]_i$  in intact living cells in response to extracellular signals.

## Results

### ***GFP<sup>LT</sup> tagged C had the expected molecular weight.***

Lysates of glucagon receptor-transfected baby hamster kidney cells (BHK/GR) stably expressing the C-GFP<sup>LT</sup> fusion protein were characterised by Western blot analysis using polyclonal antibodies directed against the NH<sub>2</sub>-terminus of C $\alpha$  (Fig. 1). In a separate experiment, lysates of BHK cells, transiently expressing either of the two fusion proteins, were characterised by Western blot analysis using polyclonal antibodies that recognise GFP (data not shown). Taken together, these experiments show that C-GFP<sup>LT</sup> fusion protein is recognised as a unique protein of the expected size by the anti-C $\alpha$  antibody in stably transfected cells and that both fusion proteins have the same molecular weight.

### ***The fusion protein localised to cytoplasmic aggregates.***

The localisation of the two fusion proteins, when transiently expressed in Chinese hamster ovary (CHO) cells, was very different. While GFP<sup>LT</sup>-C was evenly distributed throughout the cytoplasm (Fig. 2A), C-GFP<sup>LT</sup> was found in highly fluorescent aggregates in the cytoplasm (Fig. 2B). These distinct patterns for the two fusions was also seen in transiently transfected human embryonic kidney (HEK293) and BHK/GR cells (data not shown). For unknown reasons it was not possible to make stable transfectants expressing the GFP<sup>LT</sup>-C fusion, whereas this procedure was straightforward with the C-GFP<sup>LT</sup> fusion. The distribution of GFP<sup>LT</sup>-C in transiently transfected CHO cells did not change when  $[cAMP]_i$  was raised by the addition of 50  $\mu$ M forskolin (n=6, data not shown). The following results are therefore based only on work with the C-GFP<sup>LT</sup> fusion.



***Increased [cAMP]<sub>i</sub> caused the release of fusion protein from cytoplasmic aggregates.***

Within 2-3 minutes of treatment of CHO/C-GFP<sup>LT</sup> cells with forskolin, C-GFP<sup>LT</sup> fluorescence dispersed from the bright aggregates and filled the cytoplasm (Fig. 3A, 1  $\mu$ M forskolin), remaining in this distribution for as long as forskolin was present (cells were followed up to two hours). The probe did not enter the nuclear compartment to any clearly observable extent. Higher doses of forskolin increased the rate and extent of probe redistribution. The responses depicted in Figure 3B-G have all been quantified from image data, as described in the experimental protocol. Table 1 gives a comparison of the average temporal profiles of fusion protein redistribution in response to the three forskolin concentrations shown in Figure 3B. Addition of 1 mM dibutyryl cAMP (dbcAMP) (n=6), a membrane permeable cAMP analogue, which is not degraded by phosphodiesterases, caused a similar but slower response (Fig. 3C). Addition of 100  $\mu$ M 3-isobutyl-1-methylxanthine (IBMX) (n=4), a cell permeable phosphodiesterase inhibitor, caused a similar, slow response (Fig. 3D), even in the absence of adenylate cyclase stimulation. Addition of buffer (n=2) had no effect (data not shown). As a control for the behaviour of the fusion protein, GFP<sup>LT</sup> alone was expressed in CHO cells and these also given 50  $\mu$ M forskolin (n=5); the uniform diffuse distribution characteristic of GFP in these cells was unaffected by such treatment (data not shown).

To test the reversibility of the fusion protein redistribution, CHO/C-GFP<sup>LT</sup> cells were treated with 10  $\mu$ M forskolin (n=2) and washed repeatedly (5-8 times) with 37°C buffer. Although the plant terpenoid forskolin is lipophilic, it is possible to remove its effect by washing with aqueous buffer<sup>22</sup>. In these experiments, fusion protein began to return to its prestimulatory localisation within 2-3 min (Fig. 3E). In fact the fusion protein returned to a pattern of fluorescent cytoplasmic aggregates virtually indistinguishable from that observed before forskolin stimulation. To test whether the return of fusion protein to the cytoplasmic aggregates reflected a decreased [cAMP]<sub>i</sub>, cells were treated with a combination of 10  $\mu$ M forskolin and 100  $\mu$ M IBMX (n=2); when washed repeatedly (5-8 times) with 37°C buffer containing 100  $\mu$ M IBMX the fusion protein did not return to its prestimulatory localisation after removal of forskolin (Fig. 3E).

To test the probe's response to receptor activation of adenylate cyclase, stably transfected BHK/GR,C-GFP<sup>LT</sup> cells were exposed to glucagon stimulation. In these cells, addition of 100 nM glucagon (n=2) caused the release of C-GFP<sup>LT</sup> from the cytoplasmic aggregates and a resulting permanent redistribution of the fusion protein to

a more even cytoplasmic distribution within 2-3 min (Fig. 3F). Similar but less pronounced effects were seen at lower glucagon concentrations (n=2, data not shown). Addition of buffer (n=2) had no effect over time (data not shown). CHO/C-GFP<sup>LT</sup> cells, transiently transfected with the  $\alpha$ 2a adrenoreceptor (AR $\alpha$ 2a), were treated with 10  $\mu$ M forskolin then, in the continued presence of forskolin, exposed to 10  $\mu$ M norepinephrine to stimulate the exogenous adrenoreceptors. This treatment led to reaggregation of C-GFP<sup>LT</sup> within the fluorescent structures, consistent with a receptor-induced decrease in [cAMP]<sub>i</sub> (Fig. 3G).

***Rate of recovery from photobleach of C-GFP<sup>LT</sup> aggregates is dependent on forskolin concentration.***

Photobleach measurements were made to confirm that changes seen in the distribution of C-GFP<sup>LT</sup> fluorescence were a result of changes in the rate of turnover of C-GFP<sup>LT</sup> upon the aggregates. The fluorescence of an entire C-GFP<sup>LT</sup> aggregate within a cell could be effectively bleached within 2 to 5 seconds by a stationary laser beam at full intensity. After bleaching, aggregates recovered their fluorescence, indicating a dynamic exchange of C-GFP<sup>LT</sup> at these loci (Fig. 4A). The rate of recovery from spot photobleach was highly reproducible at each particular concentration of forskolin even in different cells (Fig. 4B). Both the extent and rate of recovery increased with the forskolin treatment given. Most recovery curves required at least two exponentials to fit them adequately. Given the limits of the experimental procedure, the curves are used here only to estimate half-times of recovery. To an approximation, half times for recovery can be estimated directly from the slope of reciprocal plots of the fluorescence displacement for the first few time points<sup>27</sup>. Values for half times estimated within the first 3.0 seconds of recovery (Fig. 4C) are plotted as a dose response curve in Figure 5, giving an estimated 1/2-maximal concentration for forskolin of about 3  $\mu$ M

***Fusion protein redistribution correlated with [cAMP]<sub>i</sub>***

As described above, the time it took for a response to come to completion was inversely related to the forskolin dose (Table 1). In addition the extent of a response was also dose dependent. In an automated imaging system we stimulated CHO/C-GFP<sup>LT</sup> cells with 5 increasing doses of forskolin (n=8). Images were analysed with the same algorithm used

to construct Figure 3B-G. From the results shown in Figure 5, a half maximal stimulation was observed at 1.7  $\mu$ M forskolin by this method. In parallel, CHO/C-GFP<sup>LT</sup> cells were stimulated with 8 increasing concentrations of forskolin (n=N) and the relative amount of cAMP produced was measured in a scintillation proximity assay (SPA). The ½-maximal concentration for forskolin in the SPA assay was determined to be 9.3  $\mu$ M (Fig. 5).

### ***Co-localisation of C-GFP<sup>LT</sup> with labelled ceramide distributions***

Figure 6A is an overlay of green and red fluorescence emissions from CHO/C-GFP<sup>LT</sup> cells stained with BODIPY<sup>®</sup> FL C<sub>5</sub>-ceramide (ceramide-FL). The green channel contains the ceramide-FL and GFP<sup>LT</sup> fluorescence; the red channel shows only the ceramide-FL excimer emission. The ceramide-FL probe preferentially accumulates in Golgi membranes<sup>28</sup>. This is most obvious in images formed from the red excimer emissions of the FL-ceramide. The GFP<sup>LT</sup>-bright structures do not stain with the ceramide probe indicating that they are clearly distinct from Golgi membranes.

### ***Structure of the GFP<sup>LT</sup> -bright aggregates***

Figure 6B shows an iso-surface rendering of 25 deconvolved and reconstructed through-focus wide-field images of a single large C-GFP<sup>LT</sup> aggregate. Each aggregate appears to have the structure of a convoluted tubule or glomerulus, and this is more obvious in the stereo pair (Fig. 6C) derived from the same data set from which the iso-surface rendering was made. It is not completely clear whether each structure is formed from a single fully connected tubule or a small number of discrete tubules in close apposition. The structure is however clearly compact and more complex and structured than a simple amorphous aggregation of C-GFP<sup>LT</sup> molecules. Figure 6B-C is typical of the larger aggregates which are of the order of 2 to 4  $\mu$ m across. The more numerous smaller aggregates (less than 1  $\mu$ m across) appear to share the same underlying structural component(s) as their larger counterparts.

## Discussion

The aim of the present study was to develop a transfectable probe for monitoring changes in  $[cAMP]_i$ . Since cAK is by far the major intracellular effector for  $cAMP$ <sup>2</sup>, a measure of its activation should closely reflect physiologically relevant changes in  $[cAMP]_i$ .

$NH_2$ - and  $COOH$ -terminal fusions of C subunit were made to a highly fluorescent variant of GFP. Only the C-GFP<sup>LT</sup> fusion responded to changes in  $[cAMP]_i$ . The three-dimensional structure of the C subunit<sup>29,30</sup> reveals that both the  $NH_2$ - and  $COOH$ -termini, while far apart, are both located opposite the catalytic cleft and close to the surface of the protein. Comparison with the closely related cGMP-dependent protein kinase, whose R and C subdomains are contained within the same polypeptide chain in R-C order<sup>31</sup>, suggests that the R subunit of cAK may be expected to interact with the  $NH_2$ -terminal region of the C subunit. Furthermore, the surface of the C subunit in the  $NH_2$ -terminal region is hydrophobic<sup>29</sup>, supportive of a protein-protein interaction in this area. An  $NH_2$ -terminal GFP<sup>LT</sup> tag would also prevent post-translational myristoylation (of the  $NH_2$ -terminus) of the C subunit as reported specifically for mouse  $Ca^{18}$ , while the C-GFP<sup>LT</sup> fusion may well be myristoylated. These factors may explain the very different behaviours of the  $NH_2$ - and  $COOH$ -terminal fusions of C subunit to GFP<sup>LT</sup>.

There are reasons to believe, that the C-GFP<sup>LT</sup> fusion protein behaves like the endogenous kinase both with regard to localisation and activation kinetics. Li *et al.* (1996)<sup>11</sup> have, for instance, reported that RII subunits occur as "intensely fluorescent spots" within perinuclear cytoplasm. Skålhegg *et al.* (1997)<sup>32</sup> also reported a granular distribution of RII in both human B and T lymphocytes. Also, the time frame of fusion protein redistribution in response to forskolin addition reported here, corresponds well to the observation of dissociation of microinjected  $RI\alpha_2Ca_2$  holoenzyme in response to forskolin within 1-2 minutes<sup>26</sup> and the dissociation of endogenous  $RII_2C_2$  in response to forskolin observed by immunofluorescence after less than 5 min<sup>22</sup>.

In contrast with previous work with microinjected  $RII\alpha_2Ca_2$  holoenzyme and  $Ca$  subunit<sup>21</sup>, we did not observe any translocation of C-GFP<sup>LT</sup> to the nucleus. A possible explanation could be the increased size of the fusion protein relative to endogenous C subunit. Nuclear pores are thought to allow passage by diffusion of globular proteins of less than 45-60 kDa<sup>33</sup>. The putative size limit of 45-60 kDa may adequately explain the exclusion of the fusion protein (68 kDa), yet passage of endogenous C subunit (41 kDa).

Consistent with this, a microinjected 65 kDa fusion protein of glutathione S-transferase and mouse C $\alpha$  subunit (GST-C) was excluded from the nucleus<sup>21</sup>.

That the C-GFP<sup>LT</sup> fusion can be released by dbcAMP or treatments which increase [cAMP], suggests that it must recognise and attach to endogenous R subunits (or some subset of the same) and therefore that these R subunits are naturally collected at or on the structures seen in Figures 3A and 6. Reversal of elevated [cAMP], e.g. by removal of forskolin or stimulation of G<sub>i</sub>-coupled receptors, results in rapid return of fluorescence to the original prestimulatory locations within cytoplasm. These anchoring structures therefore appear to be persistent features within the cytoplasm of CHO/C-GFP<sup>LT</sup> cells. Similar structures and C-GFP<sup>LT</sup> behaviour were also found in transfected BHK cells.

The distribution of fluorescence between aggregates and cytoplasm should reflect the position of a dynamic equilibrium within each cell, determined principally by [cAMP]. This is confirmed by results from spot-photobleach measurements. The rate of fluorescence recovery of aggregates following photobleach measures the net rate of turnover of C subunits at these sites. The rate of recovery is the sum of on and off rates for the association of catalytic with regulatory subunits at these loci, both of which will be governed principally by the concentration of cAMP within the cell (the off rate being governed directly by [cAMP]<sub>i</sub>; the on rate being dependent on the concentration of free C-GFP<sup>LT</sup> in the cytoplasm). Most aggregates completely disappear after full stimulation with forskolin. However, often one aggregate remains, and this is always the biggest and brightest from the unstimulated cell. Nevertheless, as photobleaching can demonstrate, there is active turnover of C-GFP<sup>LT</sup> even at these large fluorescent aggregates which remain in fully stimulated cells. As a further observation, there appears to be considerable mobility of catalytic subunits within the structure of an aggregate, since a stationary laser beam (approx. 0.5-1.0  $\mu$ m diameter) is able to bleach fluorescence from an entire aggregate of 2-3  $\mu$ m diameter in 2 to 5 seconds.

The lack of colocalisation of C-GFP<sup>LT</sup> and ceramide fluorescence, the position of aggregates within the cell and their unusual form, suggest that these structures are definitely not associated with Golgi, but may well be constructed of membrane tubules with C-GFP<sup>LT</sup> on the outer surface. Although we have been unable as yet to ascertain the identity of these structures, we have ruled out Golgi membranes. They may however be membranous since fusion protein is apparently freely mobile on them, possible tubular judging by the 3-D reconstructed image, and clearly the catalytic subunits are able to

bind to and release from R subunits with ease, suggesting that the latter are anchored to the surface of these structures. They are also persistent within the cytoplasm, and found in all cells transfected thus far with the C-GFP<sup>LT</sup> construct (CHO, HEK293 and BHK).

Figure 5 gives a comparison of an SPA assay conducted in parallel with two different forskolin dose response experiments using the cAK fusion protein. These experiments showed a direct correlation of three parameters: level of [cAMP]<sub>i</sub>, turnover rate of C-GFP<sup>LT</sup> at cytoplasmic aggregates, and overall degree of fusion protein redistribution. Data from these three greatly varying methods agree on an 1/2-maximal concentration for forskolin of between 1.7 to 9.3  $\mu$ M in this system. As these results show, the cAK fusion protein represents a novel and reliable probe by which dynamic changes in [cAMP]<sub>i</sub> can be measured in intact living cells as they respond to extracellular signals.

## Experimental protocol

### *Hybrid cDNA construction*

Hybrid cDNAs encoding NH<sub>2</sub>- and COOH-terminal fusions of murine C $\alpha$  subunit<sup>34</sup> to GFP<sup>LT</sup> were inserted into the multiple cloning site of the pZeoSV (Invitrogen Corp., San Diego, CA, USA) mammalian expression vector, generating the fusion constructs C-GFP<sup>LT</sup> and GFP<sup>LT</sup>-C. Briefly, cDNAs encoding C and GFP<sup>LT</sup> were amplified by PCR using the following primers:

5'-C, TTGGACACAAGCTTTGGACACCCTCAGGATATGGGCAACGCCGCCGCCGCC AAG;  
 3'-C, GTCATCTTCTCGAGTCTTTCAGGCGCGCCCAAACCTCAGTAAACTCCTTGCCACAC  
 ;  
 5'-GFP<sup>LT</sup>, TTGGACACAAGCTTTGGACACGGCGCGCCATGAGTAAAGGAGAAGAACTTT TC  
 and  
 3'-GFP<sup>LT</sup>, GTCATCTTCTCGAGTCTTACTCCTGAGGTTTGTATAGTTCATCCATGCCATGT . HindIII/AscI restriction endonuclease digested C subunit PCR amplification product and AscI/XhoI digested GFP<sup>LT</sup> PCR product were ligated with the HindIII/XhoI digested vector for the generation of the C-GFP<sup>LT</sup> fusion construct. Correspondingly the GFP<sup>LT</sup>-C construct was generated by ligating HindIII/Bsu36I digested GFP<sup>LT</sup> PCR product and Bsu36I/XhoI digested C subunit PCR product with the HindIII/XhoI digested vector. To

generate a similar construct which allowed the expression of GFP<sup>LT</sup> alone, the GFP<sup>LT</sup> PCR product was digested with HindIII/XhoI and ligated with the HindIII/XhoI digested vector.

### **Cell cultures**

CHO cells were transfected with the vectors containing hybrid cDNA for the C-GFP<sup>LT</sup> or the GFP<sup>LT</sup>-C fusion proteins using the calcium phosphate precipitate method in HEPES-buffered saline<sup>35</sup>. Stable transfectants were selected using 1000 µg Zeocin/ml (Invitrogen) in the growth medium (DMEM with 1000 mg glucose/l, 10 % foetal bovine serum (FBS), 100 µg penicillin-streptomycin mixture ml<sup>-1</sup>, 2 mM L-glutamine purchased from Life Technologies Inc., Gaithersburg, MD, USA). Untransfected CHO cells were used as the control. To assess the effect of glucagon on fusion protein redistribution, the constructs were stably expressed in BHK/GR cells (Novo Nordisk, Bagsværd, Denmark) overexpressing the human GR. Untransfected BHK/GR cells were used as the control. Expression of GR was maintained with 500 µg G418/ml (*Neo* marker) and C-GFP<sup>LT</sup> was maintained with 500 µg Zeocin/ml (*Sh ble* marker). CHO cells were also simultaneously co-transfected with vectors containing cDNAs for C-GFP<sup>LT</sup> and the human AR $\alpha$ 2a (ATCC). Transfected cells are referred to as *e.g.* CHO/C-GFP<sup>LT</sup> cells in the text.

For fluorescence microscopy, cells were allowed to adhere to Lab-Tek chambered coverglasses (Nalge Nunc Int., Naperville, IL, USA) for at least 24 hours and cultured to about 80% confluence. Prior to experiments, the cells were cultured over night without selection pressure in HAM's F12 medium with glutamax (Life Technologies), 100 µg penicillin-streptomycin mixture ml<sup>-1</sup> and 0.3 % FBS. This medium has low autofluorescence enabling fluorescence microscopy of cells straight from the incubator.

### **Immunoblotting**

Samples containing 10 µg of protein, determined according to the method of Bradford<sup>36</sup> using the Bio-Rad Protein Assay (Bio-Rad Laboratories, Hercules, CA, USA), were added to SDS sample buffer<sup>35</sup> and run on precast 7.5 % SDS-PAGE gels with a 4 % stacking gel (Bio-Rad). The proteins were transferred to PH79 nitrocellulose membranes (Scleicher & Schuell GmbH., Dassel, Germany) for an hour at 4°C using a Bio-Rad Transfer Blot apparatus (80 V). Non-specific adhesion was blocked by

incubating the membranes over night in 3 % bovine serum albumin Fraction V (Sigma Chemical Company, St. Louis, MO, USA) in Tris-buffered saline (TBS) containing 50 mM Tris pH 7.5 and 0.15 M NaCl and for an hour in 3 % skim milk powder (Difco Laboratories, Detroit, MI, USA) in TBS with 0.1 % Tween20 (TBST). The membranes were incubated for an hour in TBST with 3 % skim milk powder and the primary polyclonal rabbit anti-C $\alpha$  antibody (Upstate Biotechnology Inc., Lake Placid, NY, USA), which was raised against a peptide corresponding to a 16 amino acid N-terminal stretch of human C $\alpha$ , diluted 1:1000. After 4 washes of 5 min each with TBST, secondary antibody (horse radish peroxidase-conjugated donkey anti-rabbit immunoglobulin from Amersham International plc, Buckinghamshire, UK) diluted 1:5000 in TBS with 3 % skim milk powder was added and incubated for an hour. After 4 washes in TBST and one in TBS, immunoreactivity was detected by enhanced chemiluminescence (ECL) as described by the manufacturer (Amersham) and exposed on Biomax® MR film (Eastman Kodak Company, Rochester, NY, USA). All the steps were performed at room temperature unless otherwise stated.

#### ***Time-lapse recording of fusion protein movement.***

Cells were cultured in HAM's F12 medium as described above. The chambers were placed on a temperature regulated microscope stage and kept at 37°C. Fluorescence images were captured using an Axiovert 135 inverted light microscope (Carl Zeiss, Oberkochen, Germany) equipped with a Fluor x40, NA 1.3 oil immersion objective (Zeiss) and a cooled (-40°C) CH1 charged coupled device (CCD) camera (Photometrics Ltd., Tucson, AZ, USA). The microscope was equipped with a 470±20 nm excitation filter, a 505 nm dichroic mirror and a 515±15 nm emission filter (Delta Lys & Optik, Lyngby, Denmark). The excitation light source was a 100W HBO arc lamp.

Redistribution of the C-GFP<sup>LT</sup> fusion protein was quantified using an image analysis program custom written in LabVIEW (National Instruments, Austin, TX, USA). Fluorescent aggregates are segmented from each image using an automatically found threshold based on maximisation of the information measure between the object and the background. The *a priori* entropy of the image histogram is used as the information measure<sup>37</sup>. The area occupied by aggregates in each image is calculated by counting pixels in the segmented areas. The value thus obtained for each image in a series, or treatment pair, is normalised to the value found for the first (unstimulated) image



collected. A value of zero (0) indicates no redistribution of fluorescence from the starting condition. A value of one (1) by this method equals full redistribution.

### ***Spot photobleaching***

A Zeiss LSM 410 with x40 Fluar (as above) was used in spot scan mode at 488 nm to bleach individual fluorescent C-GFP<sup>LT</sup> aggregates within CHO cells variously treated with forskolin. Fluorescence recovery at the locus of each aggregate was monitored immediately after bleach with successive small-area raster scans just large enough to include most of the cell in which the aggregate lay. Nominal output of the laser at 488 nm, before launch into the microscope, was 10 mW. Subsequent raster scans were also run with the laser at full intensity and without a confocal aperture to allow the first to be made within 0.2 seconds of bleach, and for each scan to be completed within 0.3 seconds (100 x 100 pixels per scan). The recovery of fluorescence for the majority of bleach experiments was measured over a period of 215 seconds, recorded in three consecutive blocks of 10 scans having successive intervals between frames of 0.5, 1 and 5 seconds, and a final set of 15 scans each 10 seconds apart. A single scan collected prior to each bleach exposure served both to establish depth of bleach and to estimate maximum recoverable fluorescence in each experiment. Bleach recovery scans (8-bit images) were analysed using IPlab Spectrum software (Signal Analytics Corp., Vienna, VI, USA). A small region of interest (ROI) of between 6x6 to 10x10 pixels was used to define the area for which fluorescence recovery would be monitored in each experiment, and the average fluorescence within that ROI was measured for successive frames in each time series. The measurement ROIs were slightly larger than the bleached C-GFP<sup>LT</sup> aggregates to allow for cytoplasmic movements during the measurement period. The total average fluorescence within each frame was also measured to allow fluorescence recovery within C-GFP<sup>LT</sup> aggregates to be corrected for the minor effects of photobleaching caused by the series of measurement scans.

Results of the spot-bleach experiments are presented as normalised values of displacement from photobleach,  $\Delta F(t)$ , versus time  $t$ :

$$\Delta F(t) = [F(\infty) - F(t)]/[F(\infty) - F(0)]$$

where  $F(\infty) = F_i R_i / R_r$

$F(\infty)$  being the maximum recoverable fluorescence within a measurement ROI calculated from the pre-bleach intensity of the target aggregate,  $F_i$ , corrected for total loss of fluorophores within the cell,  $R_i/R_p$ , during the bleach exposure and recovery periods.

### **SPA**

CHO/C-GFP<sup>LT</sup> cells were cultured in HAM's F12 medium as described above, but in 96-well plates. The medium was exchanged with Ca<sup>2+</sup>-HEPES buffer containing 100  $\mu$ M IBMX. The cells were stimulated with different concentrations of forskolin for 10 min. Reactions were stopped with addition of NaOH to 0.14 M and the amount of cAMP produced was measured with the cAMP-SPA kit, RPA538 (Amersham) as described by the manufacturer.

### ***Automated imaging***

A Diaphot300 microscope (Nikon Corp., Tokyo, Japan) coupled to a camera based on the SITe back illuminated 512 x 512 CCD camera (Princeton Instruments Inc., Trenton, NJ, USA) and integrated with a digital data acquisition system using LabVIEW software was configured to allow automated focusing and image-based analyses in 96-well plates. CHO/C-GFP<sup>LT</sup> cells were cultured as described above but in 96-well plates and kept at 37°C throughout the experiments. A fluorescence micrograph of the same field of cells, initially chosen at random, was acquired before and 30 min after forskolin stimulation and analysed as described above.

### ***Endomembrane labelling with fluorescently tagged ceramides***

Golgi membranes in CHO/C-GFP<sup>LT</sup> cells were labelled with ceramide-FL (Molecular Probes Inc., Eugene, OR, USA) at 0.5  $\mu$ M for 20 minutes before washing. Ceramide-FL excited at 480 nm normally emits in the green at about 510 nm, but when concentrated (as in Golgi membranes) the fluorophore forms excimers, resulting in a shift in the emission maximum to greater than 600 nm<sup>38</sup>. Images were collected at both  $520 \pm 10$  nm and beyond 570 nm, allowing good separation of GFP<sup>LT</sup> and ceramide-FL signals.

### **Structure of the GFP<sup>LT</sup>-bright aggregates**

Through-focus images of individual C-GFP<sup>LT</sup> aggregates were collected from chilled cells with a x63 NA 1.4 oil-immersion objective. The built-in focus motor of the Zeiss LSM 410 was used to advance the objective 0.2  $\mu\text{m}$  between images, 25 images per data set. Effective pixel size in the images was 65.6 nm. Data sets were corrected for bleaching and fluctuations in illumination intensity. Out-of-focus information in the images was removed using iterative, constrained, three-dimensional deconvolution (DeltaVision from Applied Precision Inc., Seattle, WA, USA) based on a theoretically calculated point-spread function. The deconvolved images were then reconstructed into a 3-D rotational projection of 40 images (9 degrees between images) using the method of maximum intensity ray-tracing (DeltaVision, Applied Precision, Inc., Seattle, USA). Two adjacent images in this set, re-sized and pixel-smoothed, were used to create the stereo pair shown in Figure 6C. An iso-surface rendering of the 3-D reconstruction was created using Milan software (BitPlane AG, Zurich, Switzerland) (Fig. 6B).

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## Figure legends

Table 1. Time from initiation of a response to half maximal ( $t_{1/2max}$ ) and maximal ( $t_{max}$ ) C-GFP<sup>LT</sup> redistribution. The data was extracted from curves such as shown in Figure 3B. All  $t_{1/2max}$  and  $t_{max}$  values are given as mean $\pm$ SD and are based on a total of 26-30 cells from 2-3 independent experiments for each forskolin concentration. Since the observed redistribution is sustained over time, the  $t_{max}$  values were taken as the earliest time point at which complete redistribution is reached. Note that the values do not relate to the degree of redistribution.

Figure 1. Western blot analysis of lysates containing C-GFP<sup>LT</sup> fusion proteins. Total lysates of BHK/GR,C-GFP<sup>LT</sup> (A) and control BHK/GR (B) cells were probed with an anti-C $\alpha$  antibody. 500 ng of purified bovine C subunit (C) was included as a positive control and to identify the endogenous C subunit. Although the antibody clearly reacts unspecifically with several proteins in the total lysates, the fusion protein (f) is recognised as a specific band, migrating with an apparent size of 60 kDa, in the transfected cells (A). The endogenous C subunit (e) migrated as predicted by its molecular weight of 41 kDa. It is possible to compare the expression levels of endogenous hamster C subunit and overexpressed mouse fusion proteins in these blots since the immunogenic peptide is conserved between these two species.

Figure 2. Fluorescence micrographs of CHO cells expressing C subunit fusion proteins. The two fusion proteins of the C subunit of cAK show distinct localisation patterns. A. The NH<sub>2</sub>-terminal GFP<sup>LT</sup>-C fusion protein is localised almost evenly throughout the cytoplasm. B. The COOH-terminal C-GFP<sup>LT</sup> fusion protein is highly concentrated in cytoplasmic aggregates, often in one large and several minor structures per cell. Scale bar 10  $\mu$ m.

Figure 3. Time-lapse analyses of fluorescence redistribution in CHO/C-GFP<sup>LT</sup> cells treated with various agonists. The raw data of each experiment consisted of 60 fluorescence micrographs acquired at regular intervals including several images acquired before the addition of agonist. Six of these images are shown (A) for the typical response to 1  $\mu$ M forskolin, taken at the time points indicated. The time point t=0 corresponds to the image acquired immediately before the cells were challenged with agonist. Scale bar



10  $\mu$ M. The charts (B-G) each show a quantification of the responses in each time series. The total area of the highly fluorescent aggregates (see Experimental Protocol) is plotted versus time for each experiment. (B) Redistribution time profiles of the C-GFP<sup>LT</sup> fusion following treatment of cells with various concentrations of forskolin. (C) Response following addition of 1 mM dbcAMP. (D) The effect of 100  $\mu$ M IBMX on the fusion protein distribution. (E) Demonstrates the reversibility of the forskolin-induced redistribution of C-GFP<sup>LT</sup>, where 10  $\mu$ M forskolin (open arrow) is followed shortly by repeated washings with buffer (dark arrow). In a parallel experiment, treatment with 10  $\mu$ M forskolin plus 100  $\mu$ M IBMX is followed by repeated washing with buffer containing 100  $\mu$ M IBMX. (F) BHK/GR,C-GFP<sup>LT</sup> cells treated with 100 nM glucagon. (G) CHO/C-GFP<sup>LT</sup> cells transiently transfected with the AR $\alpha$ 2a were pretreated with 10  $\mu$ M forskolin (open arrow) to increase [cAMP], then given 10  $\mu$ M norepinephrine in the continued presence of forskolin.

Figure 4. (A) Four frames from the recovery sequence following spot photobleach of a large aggregate (arrow) in a CHO/C-GFP<sup>LT</sup> cell exposed to 25  $\mu$ M forskolin. Times are seconds after bleach. (B) Normalised displacement curves of the fluorescence recovery process in cells exposed to various levels of forskolin. Measurement points are averages $\pm$ sem (n=4). (C) Linear fits to the first five points of the normalised recovery curves shown in (B). The slope of each line is used as an estimate of the half-time of recovery from bleach at each forskolin concentration.

Figure 5. Parallel dose response analyses of forskolin effects in CHO/C-GFP<sup>LT</sup> cells on: [cAMP]<sub>i</sub> elevation ( $\square$ ), the rate of recovery from spot photobleach ( $\Delta$ ) and induced change in C-GFP<sup>LT</sup> redistribution ( $\bullet$ ). [cAMP]<sub>i</sub> was measured by SPA assay, analysing the effects of buffer or 8 increasing concentrations of forskolin in these cells. The graph shows a trace of the mean $\pm$ sem expressed in arbitrary units (n=4 for each data point). Half times for recovery from spot photobleach were estimated from the first 5 time points of the mean value (n=4) curves in Figure 4B. Changes induced in C-GFP<sup>LT</sup> distribution were quantified as described (Experimental Protocol) using fluorescence micrographs taken of the same field of cells prior to and 30 min after the addition of forskolin. The graph shows a trace of the mean $\pm$ sem at each forskolin concentration (n=8 for each data point). The fitted curves indicate  $\frac{1}{2}$ -maximal concentration values for

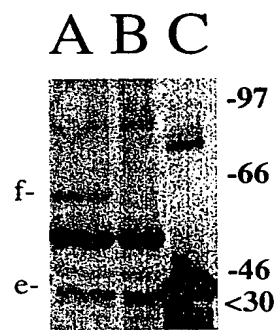
forskolin as: 1.7  $\mu$ M, image-based assay ( $\square$ ); 3.0  $\mu$ M, spot photobleach assay ( $\Delta$ ); 9.3  $\mu$ M, SPA ( $\bullet$ ).

Figure 6. (A) Two images of CHO/C-GFP<sup>LT</sup> cells stained with ceramide-FL, in emission ranges of  $520 \pm 10$  nm and  $>570$  nm, have been superimposed to demonstrate the distinct separateness of Golgi membranes (orange) and C-GFP<sup>LT</sup> fluorescence (green). Scale bar is 10  $\mu$ m. (B) An iso-surface rendering of a single large C-GFP<sup>LT</sup> aggregate (similar to that arrowed in 6A). The image is a reconstruction from 25 through-focus images deconvolved and processed as described (Experimental Protocol). Scale bar 1  $\mu$ m. (C) Stereo pair of the reconstructed images used to generate the iso-surface seen in (B). Each image is smoothed for presentation, the structure originally being 35 pixels high by 27 wide in this orientation. Scale bar 1  $\mu$ m.

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Figure 1



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Figure 2

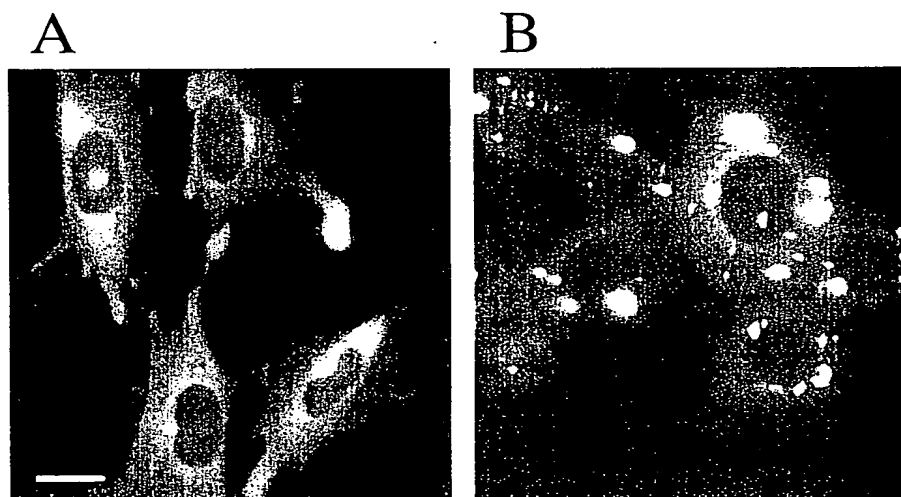


Figure 3

A

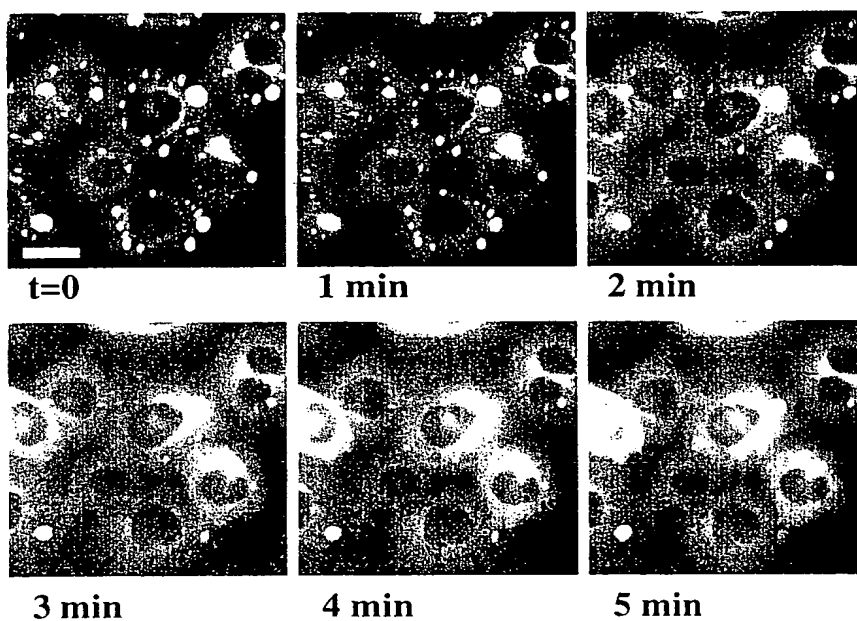
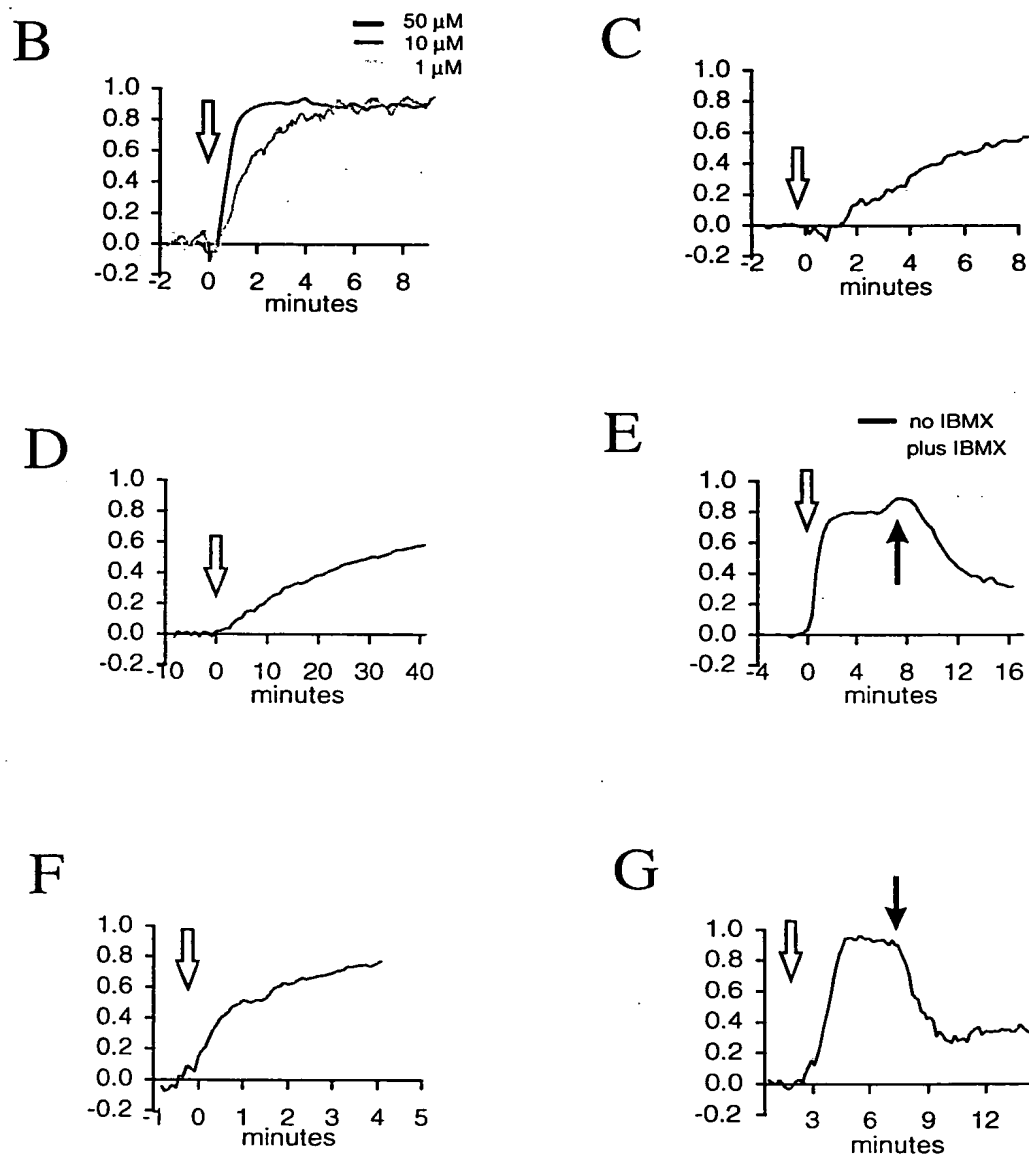


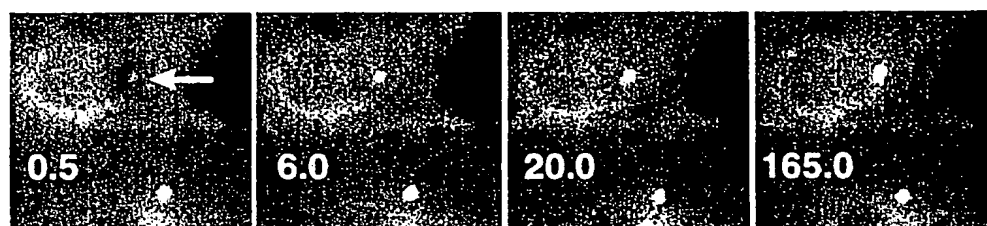
Figure 3



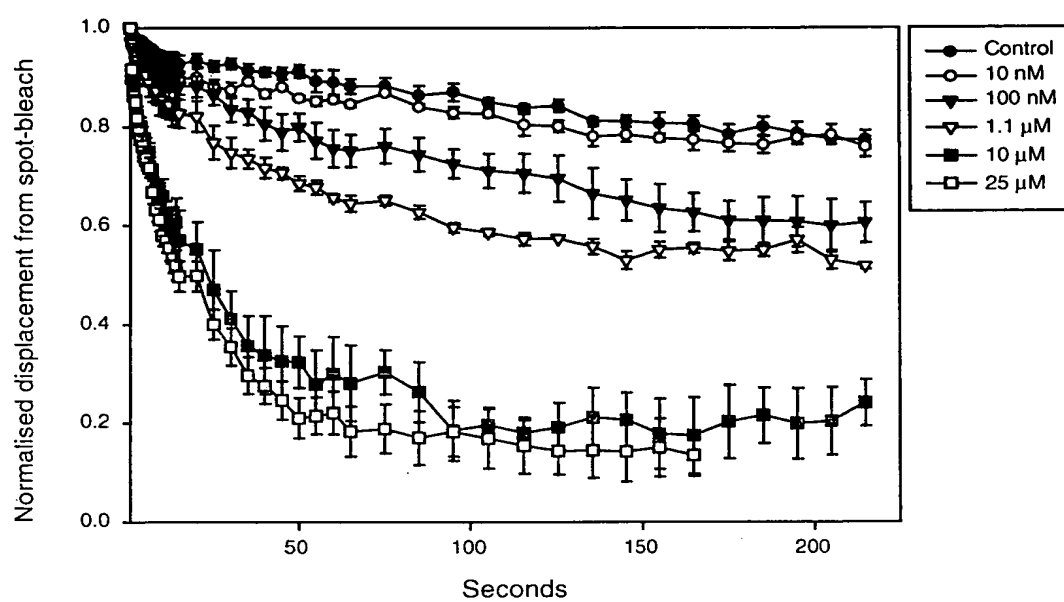
15 OKT. 1998

Figure 4

A



B



C

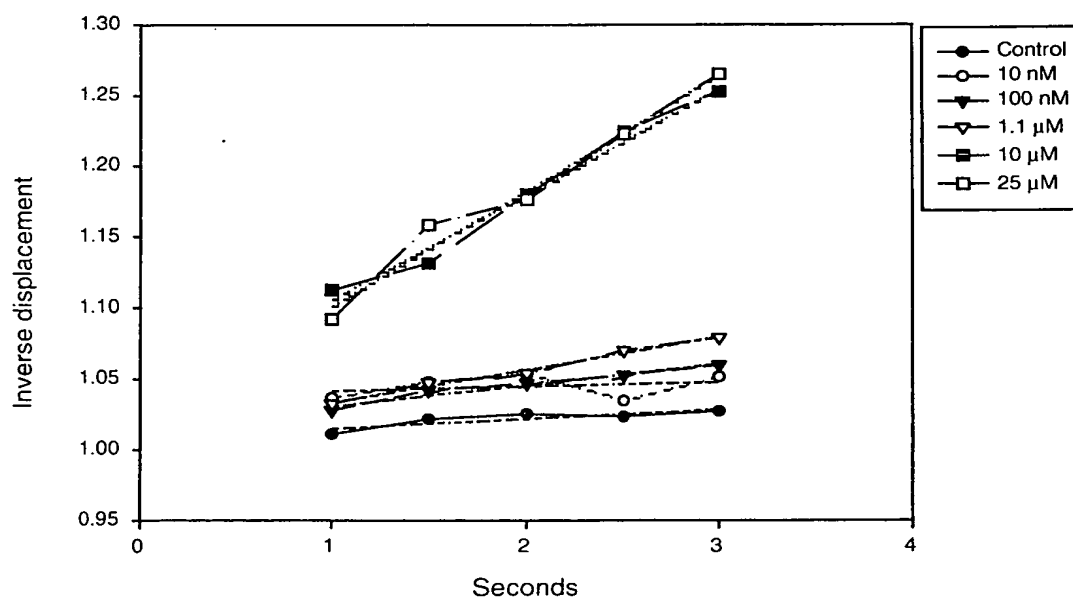
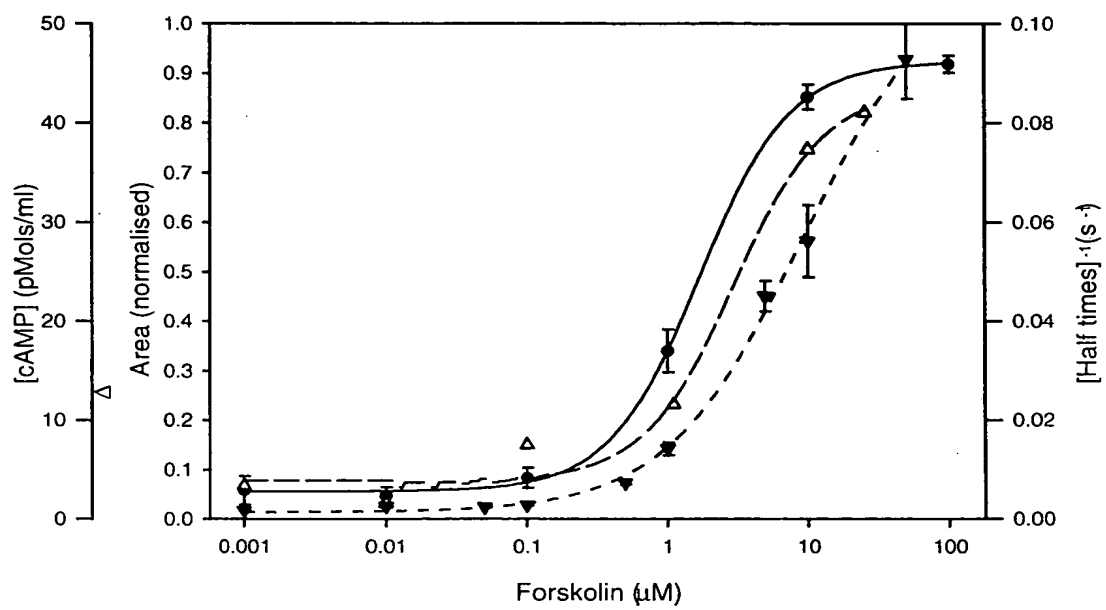


Figure 5

Modtaget PD  
15 OKT. 1998

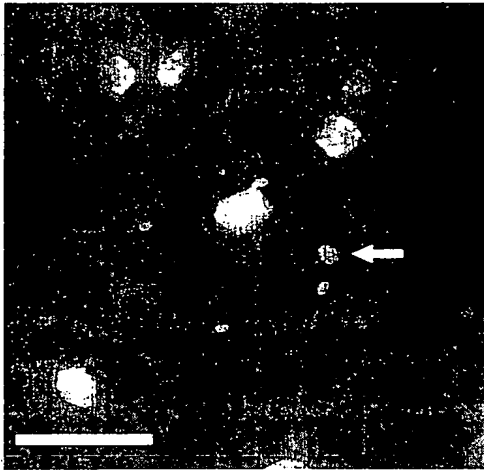




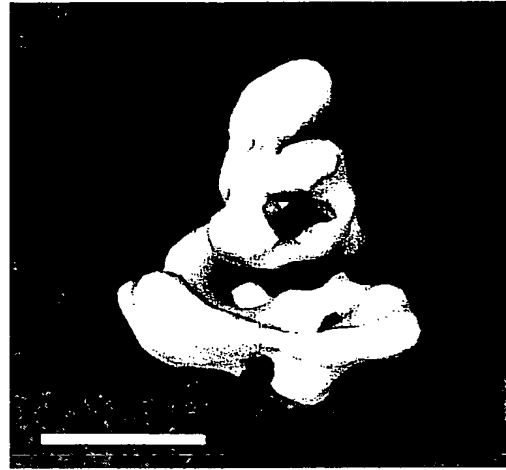
Modtaget PD 15 okt. 1998 D  
15 OKT. 1998

Figure 6

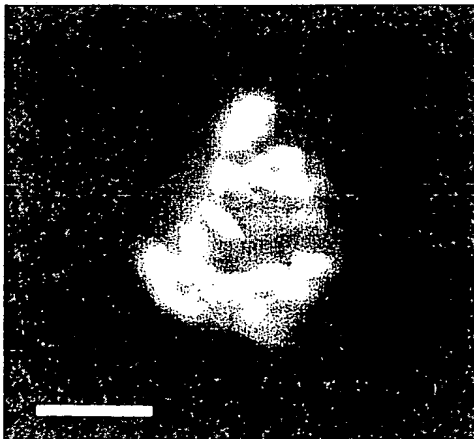
A



B



C



Left

Right

Modtaget PD  
15 OKT. 1998

Table 1

[forskolin]/ $\mu$ M	$t_{1/2max}$ / s	$t_{max}$ / s
1	115 $\pm$ 21	310 $\pm$ 31
10	69 $\pm$ 14	224 $\pm$ 47
50	47 $\pm$ 10	125 $\pm$ 28

## **METHOD AND APPARATUS FOR HIGH DENSITY FORMAT SCREENING FOR BIOACTIVE MOLECULES**

### **FIELD OF THE INVENTION**

The invention relates to a method and apparatus for screening large numbers of molecules for biological activities.

### **BACKGROUND OF THE INVENTION**

Current technology is able to generate large numbers of molecules which may possess potential therapeutic value. Compounds having potentially interesting biological activity may be products of combinatorial or traditional chemistry, a natural product, proteins isolated by one- or two-dimensional gel electrophoresis, or compounds secreted from or expressed by natural or genetically modified animal, plant, microbial or fungal cells (or parts thereof), or displayed by natural or genetically modified viral or phage particles.

Screening methods have been developed which achieve very high throughputs of test compounds. Such methods are termed Ultra High Throughput Screening (UHTS). The present generation of UHTS machines rely upon essentially serial additions of test compounds, usually one test compound per discrete test well. Test well array densities range from between 96 to 3456 wells per plate. Such UHTS machines require sophisticated technologies to dispense microvolumes of many different fluids to selected locations, and also require that the detecting surface for each test molecule generally be separated from other detecting surfaces within the array.

There is a need to develop a method which allows simultaneous screening of large numbers of test compounds for biological activity and potential therapeutic use while avoiding the complications associated with dispensing multiple fluid microvolumes.

### **BRIEF SUMMARY OF THE INVENTION**

The invention is directed to a screening method which eliminates the need for delivering microfluid volumes and allows simultaneous parallel screening of large numbers of test compounds. Accordingly, the invention is drawn to a method for screening test

compounds for bioactivity, by contacting an array of test compounds with a detector layer capable of detecting bioactivity, wherein a cell response is indicative of bioactivity.

The method of the invention is a high throughput system for parallel screening of a large number of test compounds. In one embodiment of the method of the invention, 96 to 10,000 test compounds are simultaneously screened for bioactivity in an assay; in a more specific embodiment, 96 to 3456 test compounds are simultaneously screened for bioactivity.

In a more specific embodiment, invention is drawn to a method for screening test compounds for bioactivity, comprising:

(a) contacting a solid support comprising an array of test compounds with a liquid layer, wherein the liquid layer is in immediate contact with a detector layer and wherein each test compound comes into contact with a localized portion of the liquid layer; and

(b) registering a response of the detector layer to the test compound, wherein a bioactive test compound is identified.

By "high throughput screening" is meant a method able to screen large number of test compounds for biological activity within a given machine time (i.e. at a rate anywhere from 100 to 100,000 compounds per hour per machine).

The term "parallel screening" refers to a method by which very many compounds are applied simultaneously to the detector layer, and similarly, signals from that detector layer are collected contemporaneously rather than sequentially.

By "array" is meant a regular two-dimensional arrangement of test compounds by which compounds are disposed at the nodes of a rectilinear grid pattern whereby a compound position can be identified by a simple 2-dimensional coordinate.

A "detector layer" means any two-dimensional system which can be used to report biologically relevant information. In one specific embodiment of the method of the invention the detector layer is a monolayer of living cells loaded with a fluorescent reporter dye such as Fluo-3.

By "bioactive" or "bioactivity" is meant an action or influence of a test compound upon the detector layer which results in a response from the detector layer that has direct biological significance or can be interpreted as being a biologically relevant response. Bioactive agents have the ability to effect physiological parameters of living cells and tissues. Bioactivity includes inducing or suppressing the expression of a protein, activating or inhibiting transcription of a gene, and/or effecting cellular function(s) such as, for example,

intracellular movement and storage of calcium ions, and membrane transportation.

The capacity of a test compound to affect a detector layer, i.e. bioactivity, may be determined in a number of ways known to the art. In specific embodiments of the method of the invention, bioactivity is determined by changes or movements of fluorescent probes present in the detector layer which indicate changes in ionic content, cell metabolism, growth or viability. In a preferred method of the invention, living cells form the detector layer and have specific protein components tagged with a fluorescent agent, such as green fluorescent protein (GFP); changes in GFP fluorescence or distribution within cells indicate a particular cellular response which may be selected for identification of bioactivity.

The phrase "a change in fluorescence" means any change in absorption properties, such as wavelength and intensity, or any change in spectral properties of the emitted light, such as a change of wavelength, fluorescence lifetime, intensity or polarization.

A "solid support comprising an array of multiple test compounds" or similar terms, mean a fixed matrix to which test compounds have been fixed. As an example, the solid support of the invention includes a membrane or other surface comprising an array of printed test compounds. In one specific embodiment of the invention, the test compounds are deposited as discrete spots on a porous track-etched polycarbonate membrane 10 to 20 microns thickness, the spots being between 10 microns to 2 mm diameter. The quantity of compound contained in each discrete spot will depend on the concentration of the stock solution from which it was derived, and the volume of that stock solution applied to the support. In another specific embodiment of the invention, compounds are printed onto a non-porous solid support which is optically clear.

By "test compounds" is meant a fixed array of compounds to be screened for ability to effect physiological parameters of a cell or tissue. In one embodiment, the test compounds are proteins or peptides generated by combinatorial protein chemical methods known to the art. In another embodiment, the test compounds are chemical compounds generated by combinatorial chemistry methods known in the art. In another embodiments, the test compounds are chemical compounds which are naturally occurring compounds more or less purified from their native state, are the products of genetically engineered cells, or are viral or bacteriophage particles engineered to display compounds upon their surfaces (phage display).

In one embodiment, the detector layer is an undemarcated area of living cells growing on a flat culture surface. The cells on this surface may or may not be grown to confluence,

may be transformed and/or engineered cells, or directly derived from animal tissues and grown as primary cell culture.

In one embodiment, a test compound reaches the detector layer by diffusion through a porous membrane to a liquid layer immediately overlaying the detector layer. A variety of commercially available porous membranes are useful in the method of the invention. A preferred porous membrane is a track-etched polyester or polycarbonate support in which parallel channels of identical size are formed by a selective etching process following exposure of the membrane to a source of high energy ions. The method of the invention allows each test compound affixed to a solid support to come into contact with a limited fluid volume, which fluid volume is in immediate contact with the detector layer. In one embodiment, each test compound contacts the detector layer by diffusion through a liquid-containing channel directly adjacent to the detector layer.

One advantage of the method of the invention is that it allows massive parallel screening of a large array of test compounds for biological activity. When living cells are the detector layer of the invention, they are maintained under physiologically viable conditions. Provision of these conditions requires the use of solutions able to supply essential nutrients and buffer pH changes normal to the continued growth of living cells. Such solutions may be complete cell culture media (i.e. any of those commercially available, for instance from Life Technologies Ltd.), optionally supplemented with antibiotics and serum preparations for optimal cell growth conditions. Buffer solutions may also be of the type known as "chemically defined". Cells will also require controlled temperature conditions, in the range 20° to 37°C, and the provision of gases essential to continued cell growth and maintenance of buffer capacity (O<sub>2</sub>, and optionally 5% CO<sub>2</sub>, depending on the type of buffer being used).

These and other objectives, advantages, and features of the invention will become apparent to those persons skilled in the art upon reading the details of the method as more fully described below.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

The foregoing features of the present invention may be fully understood from the following detailed disclosure of a specific preferred embodiment in conjunction with the accompanying drawings in which:

Fig. 1 is a schematic representation of the apparatus useful in one specific embodiment of the invention: Light from a high energy light source 1 is collected and collimated by unit 2, directed through a shutter assembly 3 and passes through a excitation filter-changer 4. A light guide 5 directs excitation light into the lensing and epi-illumination optics housed in unit 7. Excitation light emerging from 7 illuminates the horizontal detector layer located in the multi-component assembly having two solid layers 10 and 11 fixed relative to a supporting stage unit 8. Layer 11 is moved vertically downward on guide pins (17 Fig. 2b) controlled by arm 12 driven by unit 13. Four sprung contacts 14 attached to 12 press upon the frame of layer 11 to drive it downwards as arm 12 descends. Specified devices (3, 4, 9, 13, 15, 16) are controlled by central processing unit 6 which issues commands and collects data and status information from the devices attached to it. Unit 6 includes a central processing unit, RAM, multi-channel serial input/output cards with onboard A/D and D/A converters, one of which cards controls the camera 16 and captures images from it.

Figs. 2a-c: Figs. 2a and 2b are side view of the test stage (not to scale); Fig. 2c is a top view of the test stage. A supporting stage 8 has a rectangular central aperture the shape and size of which is the same as the area 19 of Fig. 2c. The position of stage 8 is adjusted in the horizontal and vertical axes by the 3-axis positioner 9. Components of the test stage shown include, solution layer 18, (not shown: detector layer 20 and array of test compounds 21 in Figs 3 and 4). The array 21 is held away from the liquid layer by pins 17 which pass through holes (24 in Fig. 5) in the corners of the frame 11. Arm 12 is moved down by the drive unit 13, and the four sprung contacts 14 it bears exert pressure on the frame 11 moving it down the guide pins 17 and into close proximity to the upper surface of 10, from which it is separated by a thin liquid layer 18.

Fig. 3 is a schematic showing the relative positions of the different layers in the test-array/detector layers used in one specific embodiment. The layers are depicted in apposition, as they would appear after arm 12 has pushed component 11 down the support pins 17. An array of discrete spots of test compounds 21 on a porous membrane 19 is in contact with a liquid layer 18 overlaying the detector layer 20 which is supported by an optically transparent

solid substrate **10**. The compounds fill the parallel capillary spaces in the track-etched membrane **22**.

Fig. 4 is a schematic drawing of a second embodiment of the screening method of the invention. The layers are depicted in apposition, as they would appear after arm **12** has pushed component **11** down the support pins **17**. A detector layer **20** supported on an optically clear porous membrane **19**, and overlayed by a liquid layer **23**, is placed onto an optically clear solid substrate **10** bearing an array of test compounds **21**. The thin space **18** between components **19** and **10** is filled with solution from **23** which has passed through the porous membrane **19**. Bioactivity is detected by measuring changes in fluorescence of the detector layer resulting from responses to the diffusion of test compounds through the porous membrane to the detector layer.

Figs. 5a-c are schematics illustrating transfer printing of an array of compounds onto a surface of a track-etched membrane. Compounds are stored in 16 separate 96-well microtitre plates and defined amounts are transferred simultaneously by a 96-pin printing head to the surface **19** (Fig. 5a). The contents of each successive 96-well plate are printed at a slightly offset position, generating an array after 4 such printing operations (Fig. 5b), and a full array of 1536 compounds after 16 printing operations (Fig. 5c).

## DETAILED DESCRIPTION

Before the present method and solutions used in the method are described, it is to be understood that this invention is not limited to particular methods, components, or solutions described, as such methods, components, and solutions may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting, since the scope of the present invention will be limited only by the appended claims.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, the preferred methods and



materials are now described. All publications mentioned herein are incorporated herein by reference to disclose and describe the methods and/or materials in connection with which the publications are cited.

Generally, the invention is drawn to a method for high throughput screening of test compounds, by contacting a solid support comprising an array of multiple test compounds with a detector layer, wherein each test compound comes into contact with a localized liquid which is in contact with a detector layer, and detecting a response of the detector layer to the test compound, wherein a bioactive test compound is identified.

The high density format screening system (HDFS) of the invention, rests in part on the realization that the delivery of test compounds to detector surfaces can be greatly simplified by doing away with the need for complicated microfluidics. Test compounds are applied to the detector surface in a massively parallel manner, and the method is applicable to a large range of different types of test compounds.

Central to the specific embodiments of the method and apparatus of the invention, described below, is the use of living cells as detectors, their responses being signalled via changes in the fluorescent or luminescent properties of various specific probes located within. However many different types of detector systems could be used in place of cells in such a system, for example, appropriate variants of Scintillation Proximity Assay (SPA) systems (Amersham Pharmacia Biotech) and enzyme-linked immuno-sorbent assay (ELISA) systems (Amersham).

#### Test Compound Arrays

The array of test compounds is formatted to have the same dimensions as the detector surface. In one specific embodiment of the invention, array and detector layers have a width of 8 cm and length of 12.5 cm, so as to fit within the format of conventional 96-well or 384-well microtiter plates. Preparation of the test arrays will depend on their origin.

Test compounds held in formatted arrays. Current methods for the production of single compounds by combinatorial methods are under development which involve miniaturization and patterned arrays of tethered solid-phase substrates. Thus, test compounds generated by combinatorial methods can be used to synthesize an array directly or indirectly on a carrier sheet. In one embodiment, vapor phase solubilization is used to produce a test compound array on the synthetic substrate, followed by a printing process of the test

compound array on to an absorbent membrane. In this embodiment, the test array is the printed membrane. An attractive feature of this method is that multiple copies of the same test array can be produced at one time to be screened against multiple cell systems for specific activities which minimizes stock handling from library archives.

Currently most compounds to be screened come in 96-well format. However, the 96-well format can be altered by repeated off-set printings, to any chosen density of format that the transfer substrate and assay can support. The optimum density of compounds in the test array will depend very much on the fraction of compounds in an array which generate bioactive responses in the detector layer ("hit rate"). The hit rate will depend on how well the compound library being tested matches the targets in the assay. If the hit rate is low, e.g., 1:20,000 - 100,000 compounds tested, a test array with center to center spacing of 200  $\mu\text{m}$  (giving 240,000 separate compounds in a 12 cm x 8 cm area) may be preferable, providing 2 to 10 hits per plate. At a spacing of 1 mm, 9,600 test compounds may be screened simultaneously.

The density of the format may be adjusted as required without requiring any changes in the hardware used to perform the re-formatting; rather, adjustment may be made in the degree of off-set and the number of print operations used per array.

### Detection

Fluorescent imaging provides a way to monitor physiological responses of living cells in a non-invasive manner. Ion- and voltage-sensitive probes, as well as the new generation of recombinant fluorescent probes, for instance, hybrid proteins comprising fusions of green fluorescent protein variants (GFPs) to cellular proteins involved in intracellular signaling, can be used singly or in combination to report on many aspects of cellular microphysiology. Due to the strong fluorescence of GFP, the luminescence of cells expressing the probes may easily be detected and analyzed by employing a combination of fluorescence microscopy and image analysis. Furthermore, these probes described are easily introduced into cells, as they can be expressed in the cells of interest after transfection with a suitable expression vector.

Recombinant probes for second messengers and enzyme activity, such as kinase activity, are not only useful in basic research but also in screening programs aiming at identifying novel biologically active substances. As an example, any currently used screening program designed to find compounds that affect cAMP concentration and protein kinase

activity are based on receptor binding and/or immuno detection and/or reporter gene expression. The recombinant probes described herein, on the other hand, make it possible to develop an entirely new types of screening assays able to monitor immediate and transient changes of cAMP concentration and protein kinase activity in intact living cells.

The HDFS method of the invention monitors the response of cell populations to test compounds. Lens systems are currently available which can simultaneously epi-illuminate and image the fluorescence from areas in excess of 8.5 x 13 cm, the size of a standard 96-well plate. The detection method used herein collects a variety of fluorescent signals from all cells in a field, with responses from discrete areas of the field being apparent in the real image of the fluorescence from that field as formed on the surface of the photosensitive detector (imaging camera).

#### Delivery of Test Compounds to Detector Cells

In a first embodiment of the method of the invention, delivery of large arrays of test compounds to cells is achieved with test compounds which are present on or transferred to a porous carrier sheet. In specific embodiments, test compounds are printed on the carrier sheet, and the sheet is applied (overlaid) to a field of cells of the same area. The test compounds reach the detector cells by diffusion through a localized buffer layer immediately in contact with an area of the detector cell layer. This embodiment is shown in the schematic of Figs. 2 & 3.

Porous carrier sheet for delivery of test compounds: Test compound arrays are fixed onto the porous carrier sheet by a variety of methods known to the art. For example, an array of test compounds may be transferred and fixed to the carrier sheet by the method of contact printing, whereby an array of inert flat-ended pins (e.g. made of stainless steel) is used to transfer defined volumes of individual test compounds (in the range 50 nl to 2 µl) in solution form to discrete points on a dry carrier sheet.

A porous membrane useful in the delivery of test compounds is a membrane constructed of a non-absorbent material with pores of regular and defined diameter which traverse the membrane directly from the upper to the lower side. The property of orthogonal capillarity is useful in these membranes to limit lateral spread of test compounds applied to the membranes as discrete spots of liquid, since it is important that the compounds remain as discrete spots upon the membrane. A variety of membranes of different thicknesses,

materials, and pore densities are commercially available from a number of manufacturers. For example, porous membranes useful in the method of the invention include a track-etched polycarbonate or polyester membrane (Corning Costar or Whatman/Polyfritronics). These are available in thicknesses from 6 to 23 microns, with pores of 14 to 0.015 microns, at 100,000 to 1,000,000,000 pores/cm<sup>2</sup>. For delivery of test compounds with maximum ease of handling and loading of test compounds, polycarbonate membranes are preferred, particularly of a thickness of greater than 10 microns, with pores between 1 and 10 microns diameter at densities of between 20,000,000 to 100,000 pores/cm<sup>2</sup>, respectively. One preferred membrane is Nucleopore® from Corning Costar.

Alternative membranes useful for the delivery of compounds include cast cellulose acetate (Membra-fil®), PTFE membranes (e.g. Filinert™), and glass fiber filters, all available from Corning Costar. These thicker membranes encourage lateral spread of liquid samples applied to their surfaces, but are thicker and could thus be used to deliver larger amounts of compounds.

Track-etched and cast cellulosic membranes may also be given hydrophilic or hydrophobic surface treatments. It is useful to have membranes whose surfaces have defined wettability properties.

When the test compound is soluble, the compound will dissolve into the buffer upon contact with the buffer medium, and directly contact the detector layer immediately underlying the buffer layer. In this embodiment, the test compounds dissolve upon contact with the buffer medium, and fall vertically onto the detector layer as a result of having a higher density than the surrounding liquor. It is generally preferred that the thin buffer layer between the test compound membrane and detector layer not be stirred significantly by convection. At the detector layer, the vertical fall of a solution of test compound is expected to spread radially by displacement and diffusion. The radial extent of a measured response may thus be used as an indicator of the bio-potency of the compounds involved.

Test compounds of limited solubility, such as those expressed on the surface of a carrier system, for instance, a cell membrane, viral or phage particle, must be brought into very close proximity, including direct contact, with the detector layers.

Buffer and Detector layer. The detector layer may be a continuous or non-continuous layer of living cells. In a specific embodiment, the detector layer is a continuous cell monolayer corresponding in size to the test compound array. In more specific embodiments,

thin glass substrate, suitably tissue culture treated is preferred for fluorescent probes requiring excitation wavelengths below 400 nm.

Living cells are maintained under physiologically viable conditions, as defined by such parameters as oxygen consumption, membrane potential, mitochondrial potential and cytoplasmic ion balance. Provision of these conditions requires the use of solutions able to supply essential nutrients and buffer pH changes normal to the continued growth of living cells. Such solutions may be complete cell culture media (i.e. any of those commercially available, for instance from Life Technologies Ltd.) optionally supplemented with antibiotics and serum preparations for optimal cell growth conditions. Buffer solutions may also be of the type known as “chemically defined” (e.g. phosphate buffered saline solutions). Cells will also require controlled temperature conditions, in the range 20° to 37°C, and the provision of gases essential to continued cell growth and maintenance of buffer capacity (O<sub>2</sub>, and optionally 5% CO<sub>2</sub>, depending on the type of buffer being used).

Detection of bioactivity. Detection of bioactivity may be determined by a number of methods known in the art. In a preferred embodiment, detection of bioactivity is determined by cellular imaging of fluorescence. For example, imaging may be conducted of a cell layer on a clear glass substrate. A glass substrate having a surface pitted with a regular array of very shallow (approx 20 µm) depressions may be used for this purpose (Corning). This glass substrate is useful because it ensures a regular and defined spacing between the overlying test array and the cells beneath.

In one embodiment, the detector layer is an undemarcated area of living cells growing on a flat culture surface. The cells on this surface may or may not be grown to confluence, may be transformed and/or engineered cells, or directly derived from animal tissues and grown as primary cell culture. In a second embodiment of the method of the invention, the array of test compounds is laid out onto a non-porous substrate (such as thin coverglass sheet) which is transparent or optically clear. Imaging will be through this surface, and through the cell support membrane lying above. The substrate (Fig. 4, 10) should be inert and solvent tolerant. For example, borosilicate glass sheets of about 200 microns thickness, which may be further surface-treated to give either hydrophobic or hydrophilic properties as desired. This embodiment is shown in the schematic of Fig. 4.

Detector layer: In one embodiment of the invention, the detector layer is a layer of

living cells cultured on a thin porous membrane. A porous membrane useful in the culture and transfer of cells is a transparent non-absorbent membrane with pores of regular and defined diameter which traverse the membrane directly from the upper to the lower side. A porous sheet suitable for cell growth is a track-etched polyester membrane about 10 microns thick with pores between 0.015 and 5 microns diameter at densities of between 600,000,000 to 400,000 pores/cm<sup>2</sup> respectively (Nucleopore® from Corning Costar).

Delivery of test compounds to detector layer. The porous membrane which supports the detector layer, complete with the buffer medium which overlays it, is applied onto the (dry) test array. Buffer medium wets the lower surface of the porous membrane (Fig. 4, 19) and forms a continuous thin film 23 between the array of test compounds 21 and the porous membrane 19. Test compounds diffuse up through the pores to the detector layer above. In one embodiment of the invention the detector layer is a monolayer of living cells overlaid with physiological buffer solution. The invention includes the possibility that under some conditions it is desirable to have cells grow processes through the membrane to make direct contact with substances on the test array below, with the use of a membrane having an appropriate pore diameter.

Further embodiments and general considerations. Where a test array is generated as a complex mixture of components, such as from the "teabag" method of combinatorial synthesis, or from cDNA library expression systems, a separation step may first necessary. Separation of test components may be conducted in any number of ways known to the art. In one embodiment, components may be separated by the use of one- or two-dimensional separation techniques in non-denaturing gels. The resulting gels may be used directly as test arrays.

Specific separation methods will be tailored to the components involved. Any bioactive compounds from such an array would be identified from identical copies of the original test gel.

#### Detection of Bioactivity.

Lens and illumination system. Specialized light sources and optics are needed to illuminate and image the fluorescence coming from an area the size of a microtiter plate (96-well plate). Such a system is available from: Imaging Research Inc., St Catherines, Ontario, Canada, and consists of a high-power light source directed through a specialized lens which

acts both as a wide-field epi-illuminator and imaging device.

An illumination system useful in the HDFS device is able to deliver excitation light over an area of at least 8.5 by 13 cm at an intensity sufficient to excite measurable fluorescence from that test field (which in most cases will be living cells loaded with fluorescent reporters). The illumination may come from a scanned beam, or be wide-field for simultaneous illumination of the entire area. The imaging system will collect fluorescent light from the entire test area and bring it to focus onto a sensitive imaging photodetector, such as a cooled CCD camera chip.

Screening. The practice of screening large libraries of samples of unknown composition for the few which may contain a compound of specific biological activity is one of the more common methods of new drug discovery. The samples of unknown composition are in most cases biological material, such as plant extracts or microbial fermentation broths. Screening these for biological activity is normally accomplished by performing binding assays or, more recently, functional assays. A binding assay is an attempt to find compounds of interest by identifying those which adhere with some desired affinity to cells or cell products. This can be done using fluorescent, luminescent, or radioactive detection methods. These assays are based not on a biological response, but passive processes of adherence and displacement. They cannot be construed as functional assays or as real-time assays. Another way to determine biological activity is to measure up-regulation or down-regulation of expression of a known gene. This is done by inserting DNA which codes for something which can be readily measured into a cell's genome such that the expression of interest is coupled to expression of the inserted DNA. While this is a true functional assay, it also is not a real time assay. In addition, it is only capable of finding compounds which affect gene expression. In many cases this is not the response of interest.

The CytoSensor described in U.S. Patent No. 4,915,812 and U.S. Patent No. 5,395,503 is a commercial instrument which has been billed as a screening instrument. It is based on the detection of increased cellular proton flux by means of a semiconducting electrode. The instrument is applicable to high through-put screening, but can only detect cellular events that result in changes in extracellular pH. Again, many responses of interest are not associated with changes in extracellular pH.

The growth over the last few decades in the knowledge of cellular signaling has presented extremely rich opportunities for new ways of screening for biologically active

compounds. Armed with knowledge of the biological process which one wants to affect with a new product, it is possible to monitor the actual process as a way of looking for compounds which affect it. The development of fluorescent probe molecules which upon interaction with intracellular signaling molecules (e.g. ions, enzymes, cyclic nucleotides) change their spectral properties has enabled the real-time monitoring of dynamic biological responses within living cells. Most of these probes can be introduced non-invasively into cells and will, depending on the detection system, allow characterization of cellular events in high temporal resolution (microseconds to seconds) and high spatial resolution (nanometers to micrometers). This probe technology, in combination with the technology of cellular imaging which is described below, has had a major impact on cell biology in that it has enabled monitoring of complex, cross-reacting intracellular events that could not be unravelled by conventional invasive biochemical techniques.

Imaging of cellular functions using luminescent probes. Visualization of intracellular function using luminescent (fluorescent or bioluminescent) probes has become one of the mainstay techniques in modern cell biology. Using traditional optical microscopes with quantitative detectors in place of the human eye, both the concentration and distribution in the cell of a variety of intracellular molecules of interest can be measured. While luminescent probes can be measured in large populations of cells using other techniques, imaging is the only way to learn what is going on in single cells or small populations of cells. The imaging capabilities of the HDFS apparatus will be limited to rather low spatial resolution - fluorescent changes will be imaged from the entire field of detector layer up to 8cm by 12.5 cm. When the detector layer comprises living cells, individual cells need not be resolved in the image, only the fluorescent signals from regions in which cells are present.

The imaging times will vary depending on the responses and parameters being monitored. Signaling responses, for instance changes in the level of free calcium in cellular cytoplasm, may first be seen within seconds or minutes following delivery of test compounds to the detector layer. Such changes can be monitored by changes in the fluorescent properties of specific chemical probes, for instance Fluo-3 or Fura 2 may be used to report on cytoplasmic calcium. The way in which these changes develop within cells (time-response profile) is an important diagnostic feature of the signaling processes giving rise to them. Rapid responses are therefore recorded by sequences of images, where the time between images in a sequence is between 0.1 and 30 seconds (depending on the response being



screened for). Transcription mediated events may require minutes to hours to develop. Monitoring may be continuous or intermittent. For slow responses, two images can be sufficient to gauge the level of response, the first taken before application of test compounds, the second after a period during which the response is estimated to have reached its maximum extent.

Controls relevant to the parameters being measured can be incorporated into the test arrays, both as a check for cell responsiveness and as co-ordinate markers within the arrays. The detector layer is continuous and undemarcated, but because of the close apposition of the test array to the detector layer, the center point of a response in the detector layer corresponds to a conjugate coordinate in the test array. It is helpful to have compounds in the test array which will generate known responses at known coordinates in the detector layer. Responses at the conjugate coordinates in the detector layer act as controls for the system's response, against which responses of the detector layer to unknown compounds may be compared; the points of response to control substances also act as reference points in the detector layer from which the coordinates of other responses can be mapped. For example, when bioactivity is determined as the ability to alter the level of free calcium in cellular cytoplasm, common calcium-mobilizing agonists such as carbamylcholine or adenosine trisphosphate are included in the test array at known coordinates.

As another example, when a change in the cellular ratio of inherently fluorescent NAD(P)H/FAD is the biological parameter being assayed, metabolic inhibitors such as KCN or rotenone may be used as a control and marker compounds.

In many instances, diffusion within a thin fluid layer will be involved in many applications of the screening method of the invention, and a concentration gradient will be established from each test point. Those few compounds in a test array which have bioactivity should be detected as spreading rings of response from the focus point of diffusion, within a field of the detector showing no response. The extent of the response areas (measured over time), compared with those from control substances, will provide an indication of potency and solubility of the compound responsible, and also obviate the need to make serial dilutions of test compounds. Toxic or inhibitory substances may also be determined by causing blank sectors in response rings from known agonists. Inhibitory compounds may be determined by their actions on a (pre-)stimulated detector field. Detection of bioactive compounds may incorporate simple image processing to determine the focus, extent and potency/efficacy from

the areas of activity measured in a detector field.

### Apparatus

In specific embodiments, the apparatus and method of the invention are as shown in Figs. 1-4. Fig. 1 shows a high energy light source **1**, either a mercury or xenon arc lamp, light from which is collected and collimated by unit **2**, directed through a shutter assembly **3** and passes through a excitation filter-changer **4**. A high-quality light guide **5**, either of fused quartz or a UV-compatible liquid light guide, directs excitation light into the lensing and epi-illumination optics housed in unit **7**. Excitation light emerging from **7** evenly illuminates the horizontal detector layer located in the multi-component assembly labeled **10** and **11**.

Further details of this assembly are shown in Figs. 2a-c, 3, and 4. The assembly comprises two solid layers of which **10** is fixed relative to the stage unit **8** which supports it, while layer **11** is moved vertically downward on guide pins (**17** in Figs. 2a,b,c) to bring test compounds into contact with the detector layer. Vertical movement of **11** is controlled by arm **12** driven by unit **13**. Four sprung contacts **14** attached to **12** press upon the frame of layer **11** to drive it downwards as arm **12** descends. A separate drive unit **9** controls position of the stage **8** in the horizontal plane, and also is used to adjust focus by movement along the vertical axis.

Fluorescent light emitted by the detector layer is collected by lensing unit **7**, passes through an emission filter-changer **15** and is brought to focus on the photosensitive surface of an imaging detector housed in unit **16**.

Specified devices (**3, 4, 9, 13, 15, 16**) are controlled by a central processing unit **6** which issues commands to, and collects data and status information from the devices attached to it. Collected data (images) can also be analyzed by unit **6**, or passed to a subsidiary analysis station (not shown). Unit **6** comprises: central processing unit (Intel Pentium chip, or better), RAM, multi-channel serial input/output cards with onboard A/D and D/A converters, one of which cards controls the camera **16** and captures images from it, also a video controller card, VDU, and hard disk memory units.

Figs. 2a,b,c are schematic diagrams of the test stage, which includes a supporting stage **8** with large rectangular central aperture, the shape and size of which is the same as the area labeled **19**. The position of stage **8** is adjusted in the horizontal and vertical axes by the

3-axis positioner 9. These diagrams are drawn for the specific embodiment in which the detector layer is a layer of living cells growing on the upper surface of the solid transparent component 10, which also serves to contain the liquid layer 18 which overlays the cells in the detector layer and provides them with necessary nutrients and conditions to keep them alive. The printed array of test compounds 21 is borne on a sheet of track-etched membrane 19 held by a rectangular rigid frame 11. At the beginning of the screening assay, the array 21 is not in contact with the fluid layer 18. The array 21 is held away from the liquid layer by pins 17 which pass through holes 24 in the corners of the frame 11 and which, by friction or "click-stops", prevent it from falling (Fig. 2a). At the appropriate moment, arm 12 is moved down by the drive unit 13 and the four sprung contacts it bears 14 exert pressure on the frame 11 moving it down the guide pins 14 and into the liquid 18 below to a position where it is in very close proximity to the underlying layer of detector cells 20 grown on top of the solid substrate 10 (Fig. 2b). Throughout this procedure, the entire area of the detector layer corresponding to the size and shape of area 19 is illuminated and imaged from below by the additional apparatus shown in Fig. 1.

The apparatus can also be used in a second embodiment of the screening method of the invention, where the test array is laid out on the upper surface of component 10, and components 11 and 19 are a frame and thin transparent track-etched membrane, respectively. In this specific embodiment, the frame 11 is sufficiently deep to contain culture liquid as required to sustain the detector layer of living cells growing on the upper surface of the membrane 19.

Figs. 3 and 4 are schematics to show the relative positions of the different layers in the test-array/detector layers used in the specific embodiments of the invention. Fig. 3 shows the arrangement in which an array of discrete spots of test compounds 21 on a porous membrane 19 is in contact with a liquid layer 18 overlaying the detector layer 20 which is supported by an optically transparent solid substrate 10. The compounds fill the parallel capillary spaces 22 in the track-etched membrane 19. Bioactivity is detected by measuring changes in fluorescence in the detector layer 20 resulting from responses to the diffusion of test compounds through the porous membrane to the detector layer.

Fig. 4 is a schematic drawing of a second embodiment of the screening method in which a detector layer 20 supported on an optically clear porous membrane 19, and overlaid

by a liquid layer 23, is placed onto an optically clear solid substrate 10 bearing an array of test compounds 21. The thin space 18 between components 19 and 10 is filled with solution from 23 which has passed through the porous membrane 19. Bioactivity is again detected by measuring changes in fluorescence of the detector layer resulting from responses to the diffusion of test compounds through the porous membrane to the detector layer.

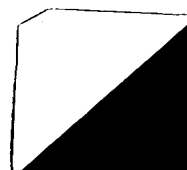
Fig. 5 is a schematic illustrating the way in which an array of 1536 compounds can be created on a membrane surface, such as would be useful in the first embodiment described above, by simple transfer printing. Compounds are stored in 16 separate 96-well microtiter plates and defined amounts are transferred simultaneously by a 96-pin printing head to the surface 19. The contents of each successive 96-well plate are printed at a slightly offset position, generating an array as shown in Fig. 5b after 4 such printing operations, and a full array of 1536 compounds (Fig. 5c) after 16 printing operations. The holes 24 in frame 11 are used to position and guide the completed array on the pins 17 indicated in Figs. 2b and 2c. The process illustrated in Fig. 5 can also be used to transfer an array of test compounds to a solid surface such as would be useful for component 10 in the second embodiment of the method described above.

## EXAMPLE

### Example 1. Screening of 1536 Test Compounds for Bioactivity.

The following description of the use of one embodiment of the apparatus of the invention in the screening method disclosed. An array of test compounds are supplied in 96-well microtiter plates, as is common practice for compounds produced by methods commonly known as combinatorial chemistry, or for compounds extracted from natural sources. In this example, the compounds are provided in soluble form, and the concentrations and solvents used have previously been tested for compatibility with the apparatus. In this example, 1536 compounds are tested simultaneously against a known cellular target, specifically a G-protein coupled receptor (GPCR) of the Gq type expressed in a transformed cell line. Gq GPCRs give clearly identifiable changes in intracellular calcium when activated.

First, physiologically viable living cells are cultured to a near confluent monolayer in a transparent culture dish (10, Fig. 2a-c) in appropriate culture medium and conditions. Immediately prior to being used in the experiment, the cells are loaded with the fluorescent



indicator of free cytoplasmic calcium concentration, Fluo-3 (from Molecular Probes, Oregon). This is accomplished by incubating the cells with a 2 to 5  $\mu\text{M}$  solution of Fluo-3 acetoxymethyl ester (AM) for a period of 10 to 15 minutes, followed by a series of solution exchanges to wash away excess Fluo-3 AM.

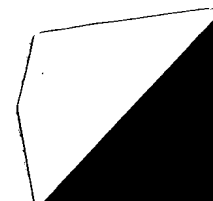
The method of transfer of compounds to the track-etched membrane Fig. 2a-c 19 is illustrated in Fig. 5. In this example, 1536 compounds are printed as an array 21 on a single track-etched membrane 19, from sixteen individual 96-well microtiter plates in the following manner: A 96-pin printing head is used to transfer defined volumes of compounds (in the range 0.05 to 0.5  $\mu\text{l}$  of each compound), one compound per pin, from each 96-well plate in turn (with wash steps between source plates to avoid cross-contamination). Each 96-point print to the membrane occurs in an offset grid, such that 16 print operations are made sequentially on the same membrane and the printed spots of compounds remain discrete and separated from each other (three of these spots are indicated in Fig. 5a, 21). Fig. 5a shows the result of a single 96-point print operation, Fig. 5b after four such operations, and Fig. 5c the finished array after 16 print operations. In this way, just sixteen print operations (and sixteen intermediate wash steps for a single print head) are sufficient to transfer 1536 compounds to a single test array. The procedure can be readily automated, and multiple copies of each printed sheet made for multiple tests.

Completed arrays are fixed to the pins 17 (Figs. 2b-c) projecting from the culture dish 10 such that they are supported some small distance above the thin fluid layer 18 covering the living cells which form the detector layer. Once the test array is fixed in place over the Fluo-3-loaded cells, the entire assembly is placed onto the test stage as shown in Fig. 2a.

The following events are synchronized by sequential instructions from the computer processing unit 6. First, the test stage is centered over the lensing unit 7 (Fig. 1) and the detector layer it supports is brought into focus by the motor unit 9. Fluo-3 is excited by light of 490 nm, and its fluorescent emissions are collected in the range 505-540 nm. The intensity of emission is increased when the dye binds free calcium. Thus the computer brings a 490 nm band-pass excitation filter into line of the light path coming from units 1 and 2 using the filter changer unit 4. At the same time, a band-pass emission filter for the range 505-540 nm is positioned in the imaging path by unit 15. The shutter 3 is opened for a pre-determined exposure period (typically 50 to 500 milliseconds), and during this time the whole area of the

detector layer is illuminated with 490 nm light. Fluorescent emission from the Fluo-3 in the cells is collected by the lens 7 and focused into the camera. The camera captures the image and sends it to the processing unit 6 where it is stored and displayed. At regular intervals thereafter, images are captured in sequence by repeatedly opening the shutter 3. Intervals between successive images are typically in the range 0.5 to 30 seconds, depending on the speed of the response expected. Intervals of 0.5 to 2 seconds are usual and sufficient to sample the dynamics of most changes in cellular calcium. At a predetermined time during this continuing sequence of images, the test array is pushed down the guide pins 17 by the actuating arm 12 and its sprung contacts 14, driven by unit 13. In close apposition to the cells in the detector layer, the test array begins to release the compounds it carries. The compounds dissolve into the liquid layer, and these fall vertically downwards onto the cells below. Because there is only a thin liquid layer between the membrane of the test array and the cells below, there is insignificant intermixing of adjacent test compounds. If a test compound activates cells below it bearing Gq GPCRs, these cells will respond with an immediate increase in free cytoplasmic calcium, and the fluorescence signal from the Fluo-3 dye they contain will increase. The sequence of images collected during the period of the response (which is typically of 1 to 10 minutes duration) will reveal which cells have so responded, and their position in the area of the detector layer will be correlated with the identity of the compound in the array above. An analysis of the entire area of each image in the sequence, performed on-line by the processing unit 6, yields the following information: the identity of the compound eliciting the response, the profile of the response with time, the intensity of the response, and also the potency of the compound with reference to a chosen standard. The latter information is contained in the radius of the area of cells responding within a particular time, and can be compared directly to a known standard which is included in the array at known points. The use of standard compounds at known points in the array also provides a control for the experiment, and helps to identify coordinates in the detector layer from which other responses can be mapped.

At the end of the screening assay, the sequence of images is stopped, the actuating arm 12 raised, and the test assembly removed. The next assembly is then moved in and the sequence begun afresh. Assembling the test units and exchanging them on the test stage can be automated by appropriate robotic control (not shown in the diagrams).

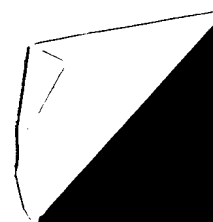


One of the advantages of the method of the invention is that the method does not require that either the components of the detector layer (e.g. living cells), or the different test compounds, be isolated from one another within discrete chambers or compartments, as is common to all high throughput screening procedures currently in use or development. The method also removes the need to dispense microvolumes of test compounds during the period of the assay itself. Delivery of test compounds to detector layers is either by direct contact or by simple diffusion across thin liquid films. Delivery and detection becomes a (massively) parallel process.

## CLAIMS

What is claimed is:

1. A method for screening test compounds for bioactivity, comprising:
  - (a) contacting an array of test compounds with a detector layer; and
  - (b) detecting a detector layer response, wherein a response is indicative of bioactivity.
2. The method of claim 1, wherein the detector layer is comprised of physiologically viable cells.
3. The method of claim 2, wherein the detector layer is supported by an optically clear substrate.
4. The method of claim 3, wherein the reactive sensing surface is held stationary in the field of view of the optical detector and the sample surface is moved into contact with it during the course of the measurement.
4. The method of claim 1, wherein the detection of step (b) is a change in a fluorescence or luminescence property of the cell.
5. The method of claim 4, wherein detection is determined with an illumination system capable of exciting the fluorescence of the reactive surface with any of a number of previously selected wavelengths with defined order and of defined time duration.
6. The method of claim 2, wherein the physiologically viable cells form a monolayer.
7. The method of claim 1, wherein the test compounds are generated on a solid support by combinatorial chemistry.
8. The method of claim 1, wherein the test compound array is generated by one- or two-dimensional gel electrophoresis.





9. A method for high throughput screening of test compounds for bioactivity, comprising:
- (a) contacting a solid support comprising an array of multiple test compounds with a cell layer, wherein each test compound comes into contact with a localized liquid which is in contact with a detector layer; and
  - (b) detecting a response of the detector layer to the test compound, wherein a response is indicative of a bioactive compound.
10. A method for simultaneously exposing an array of test compounds with a reactive sensing surface, comprising the steps of:
- (a) contacting an array of test compounds on a solid matrix with a porous membrane which is in contact with a liquid layer overlaying a reactive sensing surface layer; and
  - (b) allowing the test compounds to diffuse through the porous membrane to the liquid layer overlaying the reactive sensing surface.
11. An apparatus for screening an array of test compounds for bioactivity, comprising:
- (a) a solid support comprising an array of test compounds;
  - (b) a porous membrane; and
  - (c) a detector layer layer, wherein a liquid layer is between the porous membrane and detector layer layer, and wherein the test compounds contact the detector layer layer by diffusion through the porous membrane.

## METHOD AND APPARATUS FOR HIGH DENSITY FORMAT SCREENING FOR BIOACTIVE MOLECULES

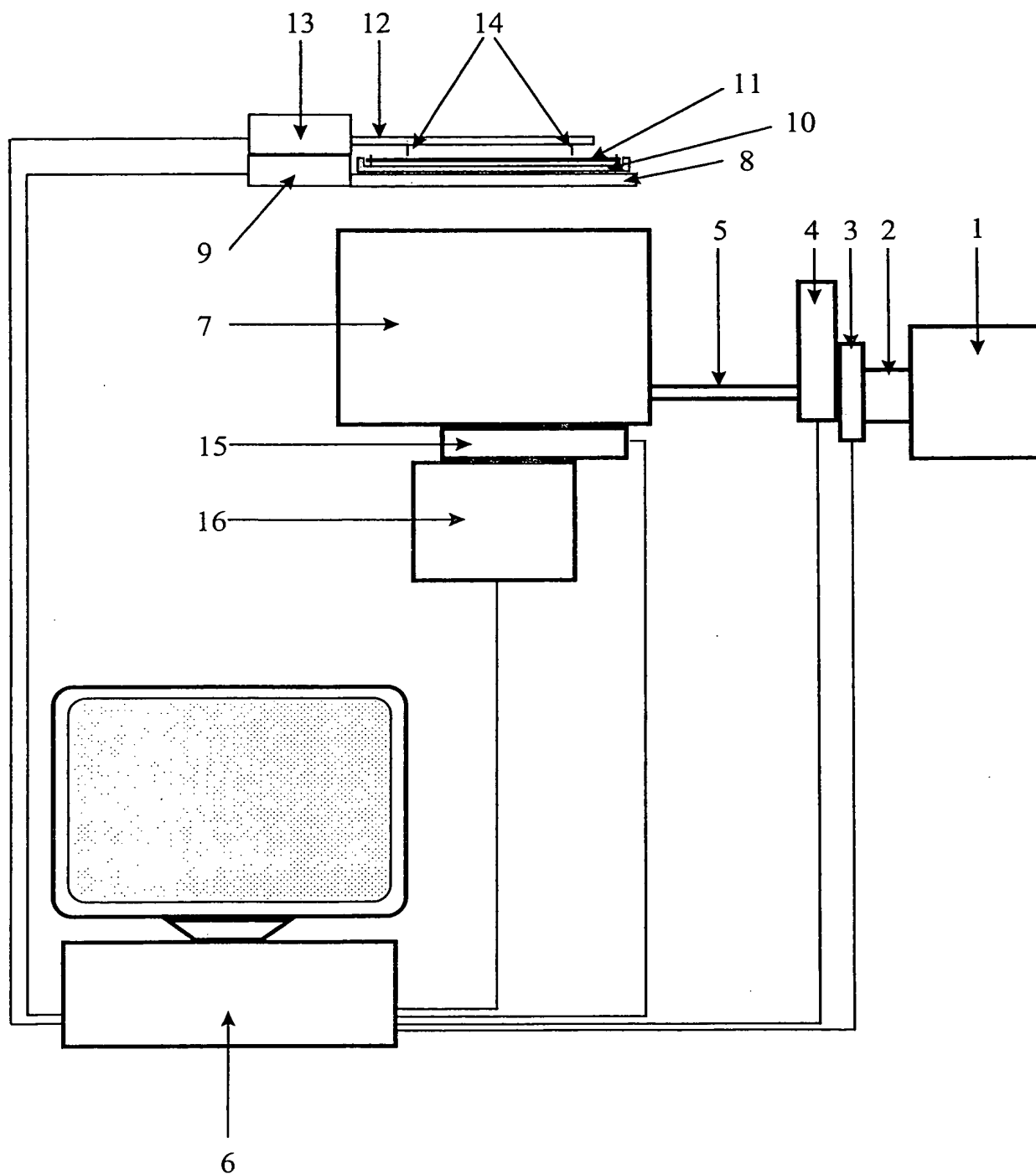
### Abstract

A method and apparatus for screening an array of test compounds for bioactivity by contacting an array of test compounds with a detector layer capable of detecting bioactivity, and detecting a detector layer response. The detector layer is comprised of physiologically viable cells. The method and apparatus allow a large number of test compounds to be simultaneously assayed in parallel.



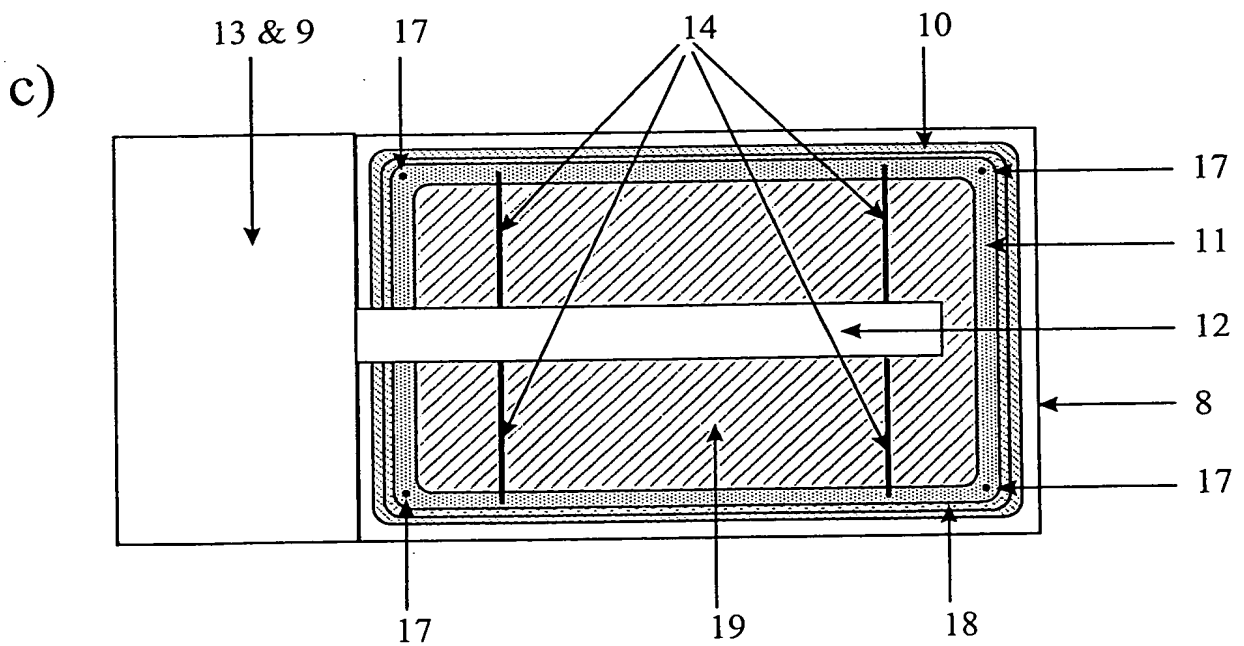
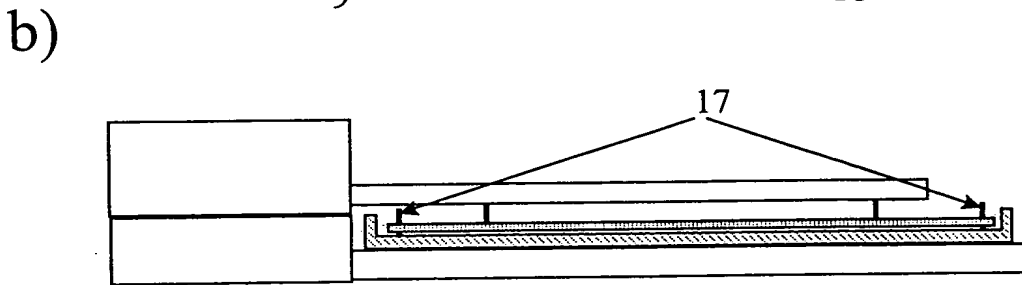
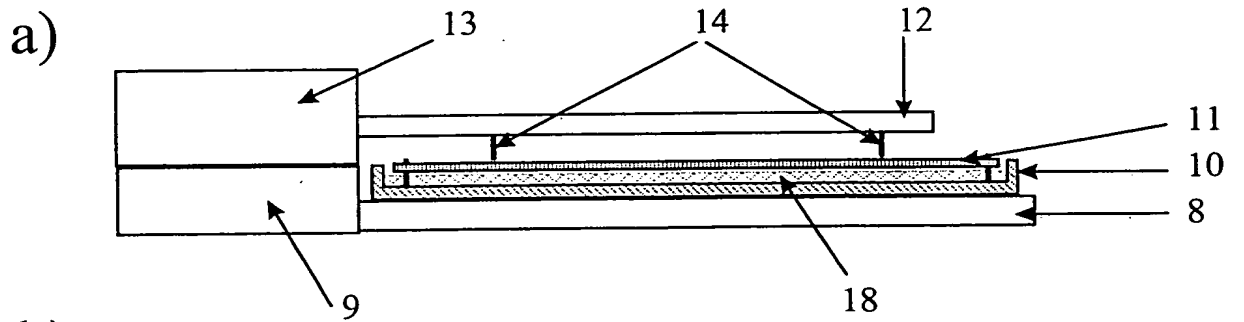
Fig. 1

Schematic view of equipment; not to scale



**Fig. 2**

**Side views of test stage; not to scale**



**Top view of test stage; not to scale**

3-D sectional representations of portions of  
the test-array/detector layers: not to scale

Fig. 3

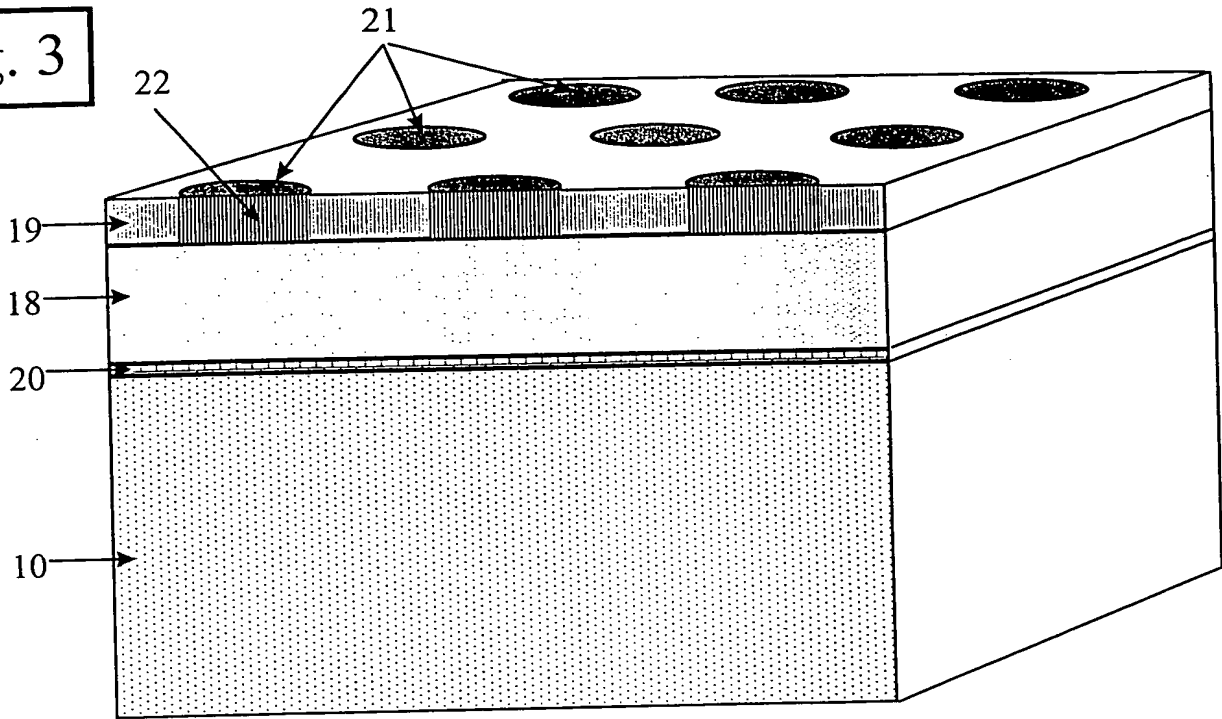
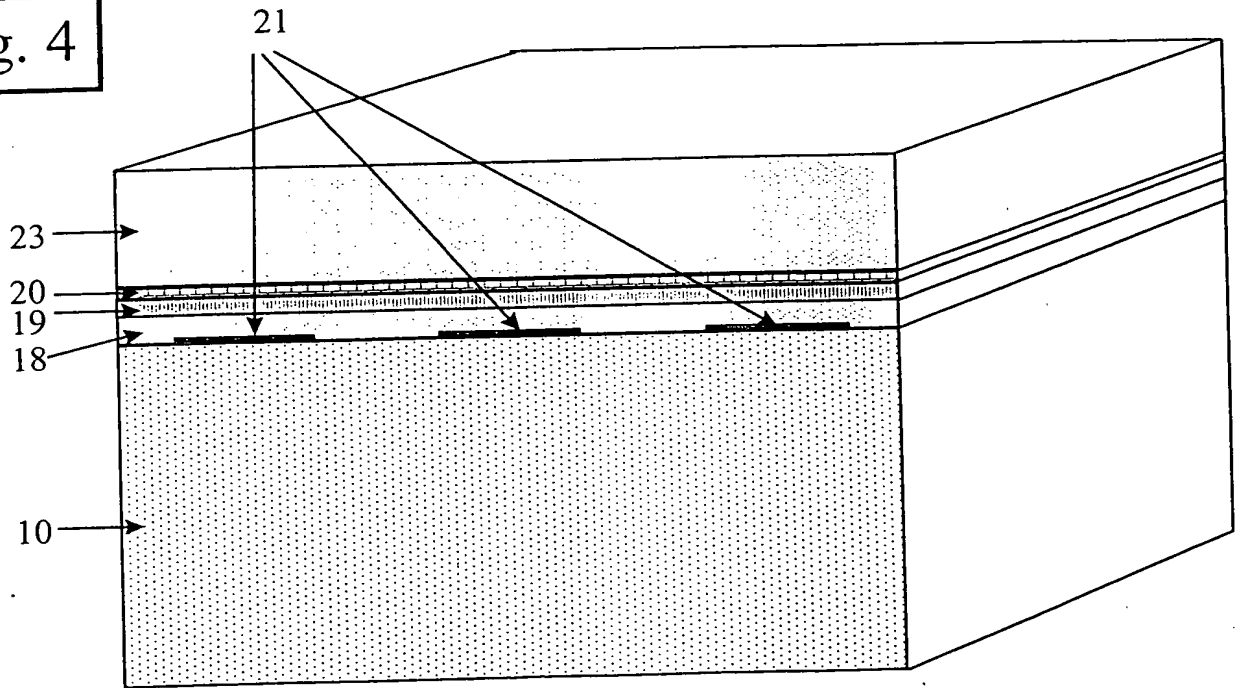


Fig. 4



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